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Instructional-cum-Practical Manual for Vocational Pupils

FARM MACHINERY

Experimental Edition

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FOREWORD

The programme of Vocationalization of higher secondary education has been accepted by the country as an area with a great deal of promise for linking education with productivity and economic development by providing education for better employability of the youth.

In view of the importance attached to the programme, the NCERT is also making all out efforts in providing academic support to the implementing agencies in the States. One of the major contributions of NCERT is in the field of curriculum development including development of model instructional materials. The materials are developed through workshops by involving experts, subject specialists, employers' representatives, curriculum framers and teachers teaching the vocation. They are sent for tryout in schools and feed back is collected through questionnaires and direct contact. They are also sent to experts for their comments before their publication.

The present manual is meant for the students of Crop Production and allied vocations. The present experimental edition will be tried-out before being published in the final form. I hope that the students of the Crop Production and other allied vocations will find this manual useful in learning about the farm machineries and in undertaking their repair and maintenance.

I am grateful to all the participants (list given elsewhere) for their interest and contributions in the workshop. I also acknowledge the immense interest taken by Prof. A K. Mishra, Head, Department of Vocationalization of Education in motivating his colleagues in the endeavour of instructional material development. Dr. A.K. Sacheti, Reader and Dr. A.K. Dhote, Lecturer, deserve my appreciation and thanks for their planning, designing, conducting the Workshop, technical editing and bringing out this manual.

Comments for improvement of this manual are welcome from its readers and users.

New Delhi
December, 1984

P. L. MALHOTRA
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PREFACE

Ever since the introduction of vocationalization in our school system by several States and Union Territories in our country the paucity of appropriate instructional materials has been felt as one of the major constraints in implementation of the programme and a source of great hardship to pupils offering vocational studies at the higher secondary stage.

The Department of Vocationalization of Education of the National Council of Educational Research and Training, New Delhi has started a modest programme of developing instructional materials of diverse types to fill-up this void in all major areas of vocational education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidelines developed by a working group of experts constituted by NCERT.

The present manual is on *Farm Machinery* and is common portion of the Crop Production, allied vocations and as well as of the Farm Mechanic vocation as such in a number of States. It contains activities (Practical exercises) to be performed by pupils with simple steps to follow, precautions to be taken and data to be obtained and processed. Each activity is complete with brief relevant information, objectives, behavioural outcomes, evaluation, etc. It is hoped that the pupils will find them immensely useful.

The pages that follow contain a draft of the writing which will be finalized after obtaining the responses and feed-back from pupils, teachers and others concerned.

The users are requested to complete the questionnaire appended and return it to us. Comments and suggestions for improvement of the material are also welcome.

The material has been developed by a group of experts as authors in a workshop held at the Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad, Andhra Pradesh. The names are mentioned elsewhere and their contributions are admirably acknowledged. Our thanks are also due to Prof. G. Ramana Reddy, Prof. & Head, Department of Agricultural Engineering, College of Agriculture, APAU, Hyderabad for the pains he took in varyfying the authenticity of contents of the manual. Dr. A. K. Sacheti, Reader and Dr. A. K. Dhote, Lecturer, Department of Vocationalization of Education deserve special thanks for editing and bringing the material in the present form. The assistance of all in the APAU, Rajendranagar, Hyderabad, Andhra Pradesh and Department of Vocationalization of Education, NCERT is also thankfully acknowledged.

New Delhi
December, 1984

ARUN K. MISHRA
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INTRODUCTION

About 20 different groups of vocational courses in agricultural area have been introduced by the nine States and three Union Territories, so far. These courses are in vogue for the last 2-7 years. From the very beginning, the Department of Vocationalization of Education of NCERT is working hand in hand with the State functionaries through various programmes organised for the State officials, vocational teachers and others. In fact, by now the Department has conducted on-the-spot studies of vocational programme for quite a large number of the States to find out the merits and demerits of the programme and to suggest appropriate measures to solve the issues pertaining to the scheme. Beside these studies, the Department has also organised short-term teacher training programmes in agriculture. All these programmes have revealed that there is a great dearth of suitable texual/instructional materials, specially the need of practical manuals was urgently felt. Supply of instructional materials and imparting of practical training becomes still more essential when one looks at the purpose with which the vocationalization of education scheme has been launched. The main aim is to prepare the pupil for purposeful and gainful employment (wage or self-employment).

To develop models of instructional materials the Department constituted a Working Group to formulate guidelines for the development of different types of instructional materials and to prepare brief examplery units.

Based on the guidelines supplied by the Working Group, Crop Production which is an important and popular vocational course in agriculture was selected for the purpose of development of instructional materials in phased manner. To begin with, development of instructional-cum-practical manual was taken up. Later, the work of teacher's guide development and text books writing shall also be taken up.

The content of the Crop Production and allied courses offered by the States and Union Territories under different titles was thoroughly analysed and it was felt appropriate to develop seven such manuals to cater to the needs of the course. The present manual is one of them. While developing the manual, care was taken that it should include maximum number of Activity Units (practical exercises) so that it fulfills the requirements of the course prescribed by the States and Union Territories in the Crop Production group of courses and also other vocational courses like 'Farm Mechanic' and others. Crop Production group includes courses like crop science, principles of crop production, agriculture.

This manual is envisaged to help both teachers and pupils in the pursuit of Farm Machinery—a part of the vocation. It explains 'what', 'why' and 'how' of the Activity Units which are essential to develop required vocational skills in the pupils.

In the manual each Activity Unit has been dealt in several sub-heads, viz., instructional

objectives, relevant information, precautions, materials required, procedure, observations, calculations or results if any, expected behavioural outcomes and questions.

Before commencing with actual work for any Activity Unit, the teacher should know what exactly pupils have to learn and do and whether they will be able to do that ? Therefore, in the beginning instructional objectives in behavioural terms should be framed by the teacher for the pupils.

In order to acquaint the pupils about the Activity Unit the teacher should provide them with required theoretical knowledge or information relevant to the Activity. This will help the pupil in proper understanding of the Activity Unit. In other words 'what' and 'why' part of the Activity Unit should be explained well in advance by the teachers.

Once the pupils have understood the relevant theoretical informations, the teacher should tell them about the precautions which are to be followed before and during actual execution of the Activity Unit. This will facilitate their smooth working. 'How' part of the manual will be described in the 'procedure' which pupil will follow while performing the Activity Unit.

Under the sub-head 'observations', the pupil shall observe the situation, take readings, and similar other points as suggested under each Unit which may vary from Unit to Unit. Whatever calculations are required to be done to obtain the results, they are also mentioned under this head or in separate head.

At the end of the Activity, the pupil shall acquire certain abilities which should be closely related with instructional objectives given under each Activity Unit. These abilities shall be listed under the sub-head 'expected behavioural outcome'. Evaluation shall be based on the abilities acquired and it will be done by the concerned teachers.

For evaluating each aspect, the teacher will use 4 point scale i.e. A, B, C & D and for each Activity Unit, Grade Point Average can be calculated as indicated below :

Suppose there are four aspects or abilities and each carries equal weightage and a pupil obtains 2A's, 1 C and 1D and if A=4 points, B=3 points, C=2 points, D=1 point, based on the grades the pupil will get 11 points and when this is divided by the total number of aspects examined it will give Grade Point average, in this case it is 2.75. Tabular presentation is as under :

Aspects	*Weightage*	*Grades obtained*	*Total points* $\frac{\text{Weightage x point equivalent to grade obtained}}{}$	*Grade Point Average*
1	1	A	1×4=4	
2	1	C	1×2=2	
3	1	D	1×1=1	$\frac{11}{4}$ =2.75
4	1	A	1×4=4	
			11	

A=4 points, B=3 points, C=2 points, D=1 point

In the last, some questions related with the Activity Units are also given, the pupils shall write the appropriate answers after the completion of the Activity Unit and teacher shall examine them. If required, he shall do suitable corrections and give suggestions. However, answer to these questions will not be considered for the purpose of grading.

FARM MACHINERY

As is well established, farm machinery has come to be a vital factor in successful crop production. The high cost and scarcity of farm labour has made the use of machinery imperative. It is the machinery on the farm which makes it possible for such a small number of farmers to produce sufficient food for our increasing population. Even though excellent design of farm machinery is available unless it is used properly its utility becomes futile. Proper adjustments and care improve the quality of work done by the machinery and render the machinery versatile to varying conditions. An understanding of the construction and basic adjustments of the machines employed in crop production, besides thorough knowledge of overhauling and conditioning of farm machines well in advance of their use in the field, can be generated through a systematic and practical study of farm machinery in the laboratory, repair shop and in the field.

The manual, step by step introduces the skill with appropriate interaction with crop sequences and operational needs. The Activity Units are introduced in such a way that the pupil acquires required confidence with regard to handling and operating of agricultural machines for seed bed preparation, seeding, harvesting, threshing and equipment used for irrigation and plant protection with confidence. Examples have been included to emphasize principles and to facilitate an understanding of the subject matter.

While the metric units of weights and measures have been used in the text, conversion tables for change of units from one system to another are given in the appendix.-III. Important reading material has been suggested (Appendix-II) besides the list of manufacturers of agricultural machines (Appendix-IV). An appraisal of energy gadgets has been tailored to this manual with a view to offer an overall purview of the concept of power-energy inter-relation in general and practical appreciation of their role in the crop production in particular.

1. Activity Unit

SHOP TOOLS FOR REPAIR AND ADJUSTMENT OF FARM MACHINERY

1 1 Instructional objectives :

The pupil should be able to :

—differentiate machines and tools ;
—use tools for forging, fitting, welding and drilling ;
—acquire broad knowledge of marking and cutting sheet metal, punching, drilling and filing ;
—acquire skills for removal and fitting of bolts and nuts, rivets and screws ;
—acquire skills in sharpenning tools and materials.

1.2 Relevant information :

Workshop tools :

Basically a farm machine consists of a carrier or a frame on which working components are mounted. These components are integrated through clamps, welding, bolts and nuts or rivets. These jobs require the following workshop tools ;

Hammer is used for bending material, riveting, pulling or fixing of nails.

Hacksaw is used for cutting sheet metal, pipes, rods, flats and bars.

Vice is used to hold job intact for cutting, bending, filing and twisting.

Drills are used for making holes of different diameters by choosing appropriate drill bits, and centre punching the spot for drilling.

Files are used for smoothening rough surfaces of wood and metal.

Chisel is used for chipping or cutting.

Fasteners like screws, rivets, bolts and nuts, clamps and nails are used to connect two different parts intact.

Tools like wrenches, spanners and screw drivers are used for fixing or removal of fasteners.

Pliers are used for cutting, bending and twisting.

1.3 Precautions :

—Select proper tool for proper job.
—Do not use worn out tools.
—Clean the tool after use and place them at proper place.
—Do not apply undue pressure when certain resistance is encountered in achieving the job of spanner, wrench or screw driver.

1a. Sub-Unit : General familiarity in the use of spanners.

1a. 1 Precautions

Use box wrench, nose wrench and pipe wrench depending upon the specific case.

1a. 2 Materials required :

i. Adjustable head wrench
ii. Spanner
iii. Extension pipe
iv. Kerosene

1a. 3 Procedure :

– Clean the portion from where nut and bolt is to be removed.
—If rusted or jammed, pour some kerosene oil over it and allow it to soak properly.
—Examine whether the bolt and nut rotate together ; if so hold head of the bolt with a spanner to prevent rotation.
—Use another spanner for unscrewing the nut.
—If need be, use an extension pipe for better leverage.

1a. 4 Observations :

The pupil should take the following observations :
—Note the direction of rotation of spanner/ wrench movement.

_____

—Record if the bolt and nut get tightened or vice versa.

_____

—Tabulate the structural/ functional differences between adjustable head wrench and a spanner.

_____

_____

_____

1b. Sub-Unit : General familiarity in the use of screw driver and fixing of an electrical socket on a wooden block for plug connection.

1b. 1 Precautions :

Use the correct size of screw driver, otherwise head of the screw will be damaged and consequently the removal will be difficult.

1b. 2 Materials required :

i. Screw drivers
ii. Nails
iii. Hammer
iv. Screws
v. Wooden block, socket, scriber

1b. 3 Procedure :

—Take a wooden block.
– Keep the socket over the wooden block and with the help of a scriber mark the positions of the screws.
—Make impression for inserting screws.
—Open the socket (component cover) for insertion of wires.
—Locate the terminals and remove the screws.
—Strip off the insulation (rubber/plastic) and twist the terminals.
—Insert the wire terminals with care and tighten these screws.
—Place the socket on the board and fix the screw vertically with a screw driver.
—Replace the cover.

1b. 4 Observations :

The pupil should take the following observations.
– Observe whether the screws have left or right handed threads.

_____

—Observe the direction in which the screw should be rotated so as to get it inward.

—Observe whether length of the screw exceeds the thickness of the block.

1.4 Expected behavioural outcomes :

The pupil will be able to :

Grade

—differentiate the shop tools ;
—develop an analytical approach for correct choice of tools for specified jobs ;
—gain competence in using correctly spanners and screw drivers in farm machinery.

The teacher should evaluate the pupil for the above abilities.

Note : Time taken and workmanship should be taken into account for evaluation.

1.5 Questions :

i. Why centre punching is required before drilling ?

ii. In which direction (clockwise or anti-clockwise) the screw rotates while being tightened ?

iii. Write down the purposes for which the spanners and screw drivers are used.

iv. While opening a nut and bolt, when and why kerosene is required ?

v. Why soap pieces are used while inserting wood-screws into jobs ?

vi. When an additional force is required to unclamp a bolt/nut ? When pipe

liverage is used and how does this help ?

vii. Name the types of spanners which are commonly used in the workshop.

2. Activity Unit

FAMILIARISATION OF FARM MACHINERY, IMPLEMENTS AND HAND TOOLS

2.1 Instructional objectives :

The pupil should be able to :

—know various types of farm machinery essentially required for crop production programme ;

—identify the machinery and implements used for primary and secondary tillage operations ;

—understand the working of plant protection equipment ;

—develop competency in the use of irrigation equipment ;

—familiarise with harvest and post harvest machinery and implements.

2.2 Relevant information :

2.2.1 What is tillage ?

Tillage is the basic operation in farming. It is done to create a favourable condition by improving physical condition of soil for seed placement, for proper germination and plant growth. Tillage includes ploughing, harrowing and mechanical destruction of weeds and soil crust. According to usage of implements, tillage operations are grouped under two main heads :

Primary tillage :

The operations performed to open-up any cultivable land for preparation of seed bed are termed as primary tillage. It is done mainly with heavy implements like ploughs, harrow ploughs, sub soilers, disc tillers or rotary tillers.

Secondary tillage :

Lighter and finer operations performed after primary tillage for obtaining better crop growth through effective tilth are termed as secondary tillage. These operations are generally done with the implements like harrows, cultivators, puddlers, weeders, ridgers, pulverisers and special tools for surface tillage to conserve moisture and to destroy weeds.

2.2.2 Classification of tillage implements :

Tillage implements are classified according to the source of power as under :

a) *Hand operated tools :*

These are operated by human-being through pulling, pushing or both. In view of the limited power, the use of these tools is limited for small scale jobs on smaller holdings.

b) *Animal drawn implements* :

These are of two types :

(i) Walking type and (ii) Riding type. The walking type implements have no provision for the operator to sit and hence involve drudgeous operation. The riding-type implements have sitting provision for the operator and implement is supported on two wheels.

c) *Tractor operated implements and machinery* :

These are operated at higher speeds, cover larger area with minimum time. Implements are trailed, semi-mounted or mounted. Some of the stationary jobs are also performed by the tractors.

2.2.3 Classification of machinery and implements according to farm operations and soils :

Farm machinery and implements are classified as under based on soil and operation :

a) Land development equipment
b) Seed bed preparation implements
c) Seeding and planting machines
d) Inter cultivation implements
e) Plant protection equipment
f) Irrigation equipment
g) Harvesting and threshing machines
h) Winnowing and processing machines

a) *Land development equipment* :

Plough : It is a basic tillage implement used for breaking the hard crust which does simultaneous operation of stirring, part pulverisation and inversion of soil. Although wooden ploughs are still in use in our country, a modified version of metal share has now been introduced for better operations. The animal drawn ploughs are generally single bottom. However, they may be of two or more bottoms in case of tractor drawn ploughs. The ploughs are classified as iron plough, mould board, chisel, lister and disc plough.

Leveller : In irrigated areas land levelling is an essential operation to ensure optimal utilisation of irrigation water. Levelled fields receive uniform penetration of irrigation water with high efficiency. Land levelling is usually done by wooden logs or planks. The other improved types of land levellers are *karaha* or scraper, land plane, terracer blades, *keni*, buck-scraper, *bakhar*, etc.

Bund former : It is used in irrigated field to make small bunds for harnessing/retaining water. This also facilitates to collect rain water and enrich sub-soil moisture.

b) *Seed bed preparation implements :*

Seed bed is prepared in developed land for better tilth. Improved aeration and moisture holding capacity ensure better tilth. Implements like harrows, cultivators, clod crushers, etc. are used in irrigated land. Puddlers are used in seed-bed preparation of paddy land for crushing the clods and pull resistivity.

Harrows : These are used to prepare the land by breaking clods, cutting weeds, pulverising soils and smoothening soil surface in dry land farming. The harrows may be disc, spike/tooth, spring or blade type.

Cultivators : They are used for manipulating the soil to maintain good tilth, and to achieve rapid infiltration of rainfall and adequate aeration, which in tern prevents surface evaporation losses and controls weeds for better utilisation of water and nutrients by the crop. Cultivators may be of shovel type, disc type and blade type. Sweep is a special type of cultivator useful for dryland. Tynes and spikes are used to stir the soil.

Clod crushers and levellers : These implements are used immediately after ploughing or harrowing. The main purpose is to crush the unevenly ploughed soil to produce a smooth and well packed seed bed. The use of heavy rollers as clod crushers is particularly practised in dry farming areas. The common material used for this purpose is wood, stone or concrete roller.

Planks : They are generally made of hard wood to pack up the loose soil and ensure even seed bed for sowing of seed. They are also used immediately after sowing of seeds to ensure proper coverage of seeds with soil.

Puddlers : Puddling is a common farm operation in paddy growing areas. The production and productivity of paddy crop increase with good quality puddling. This is

done in standing water 5 to 10 cm depth. For this, puddlers are available—hand operated, animal drawn or tractor drawn. Puddler changes the structure of the soil into massive one. Straight bladed, helical bladed and fan-type puddlers are commonly recommended for soil manipulation.

c) *Seeding and planting machines :*

Seed drill : It is used to place the required quantity of seeds in line at desired depth to ensure proper germination. The depth of placing the seed depends on types of soil and availability of moist zone. It opens the furrow to a uniform and desired depth, drops seeds uniformly without injury and covers the seeds and compacts soil around them. The seed drill may be single or multi-rows depending upon the source of power available on the farm.

Seed-cum-fertilizer drill : It is an integrated machine for placement of fertilizer in relation to seed in the soil. The rate of flow and placement is regulated through metering devices and use of special type furrow openers.

Planting machines : These are used for row drilling or check row planting of seeds larger in size than those which normally go through common seed drills. They maintain seed to seed distance in rows to facilitate inter cultivation. These planters are generally used for crops such as maize, cotton, potato, sugarcane, groundnut, etc.

Transplanter : This implement has picked up its usage in paddy growing areas where seedlings from nursery are directly planted in well puddled field at desired row and plant spacing. Manually operated transplanters have been developed in the country to meet the local requirements. However, power operated transplanters are available in the Eastern paddy growing countries.

d) *Intercultivation implements :*

These implements are designed to work in between the rows when the seedlings have emerged. They are primarily used for destroying weeds, mulching of soil, earthing the plants, and to prevent surface evaporation losses, thus ensuring adequate aeration. The commonly used tools for intercultural operations include cultivators, hoes, weeders, etc. Some of them are manually operated and others are either animal drawn or tractor drawn.

Ridger : It is used for making field furrows or channels, earthing-up and similar other operations. This has a 'V' shapped share either rigidly fixed or hinged. It may be operated by one or two pairs of bullocks

Junior planet hoe : This implement consists of expandable tynes positioned in staggered manner.

e) *Plant protection equipment :*

The chemicals for protecting the plants from various pests, diseases and weeds need to be applied on plant surfaces in the form of sprays, dusts and mist. For this purpose different types of spraying and dusting machines are available. These machines are classified as :

Hand operated machines : They are suitable for small holdings and are operated at pressure ranging from 1 to 7 Kg/sq. cm.

Power operated machines : They are suitable for treating a large area and are operated at pressure from 20 to 55 Kg/sq. cm.

f) *Irrigation equipment :*

Irrigation pumps : They are operated either by tractors, stationary engines or electric motors. The size and capacity of the pumps vary according to their design.

Improved water lifts : The water is lifted from its source for irrigation through improved

devices. These devices can be profitably used where underground water level is upto 3 to 5 metres. They are operated manually or with the help of animal power. Some of the popularly used water lifts are Persian wheel, Archemedian screw, chain washer pumps, piston pumps, etc.

g) *Harvesting and threshing machines :*

Sickles, threshers, winnowers, shellers, crushers and chaff cutters are the commonly used farm machinery at the later phase of the crop production.

Sickle : It is a universal tool popularly used for manual harvesting of crop. The type and design of the sickles vary according to the regions. However, the cutting portion should be preferably serrated to involve minimum energy and to improve the efficiency of operation. Size and shape of handle vary from place to place.

Thresher : It is used for removing the grain from the plant by striking, beating or rubbing against an object. It is developed to perform the above operation including cleaning, grading and collection of grains in a bag simultaneously. Threshers are of three types *viz.* manually operated, animal drawn and power operated.

h) *Winnowing and simple processing equipment* :

Winnower : It is either manually operated or power operated and is used for separating the grains from a mixture of grain and chaff in an air stream created artificially or naturally. Winnowing operation is very common in India and is generally done on threshing floor. Apart from cleaning the grain from chaff and bhusa, some winnowers are also designed to grade the clean seed as well.

Chaff cutter : The machine used for chopping fodder is called chaff cutter. There are hand chaff cutters, animal operated or power drawn. Depending on the form of cutting head, chaff cutters may also be classified as (i) cylinder cutting head machine and (ii) fly-wheel type cutting head machine.

Castor sheller : It is a machine used for shelling castor capsules and to separate castor beans from empty shells by winnowing and sieving. The shelling takes place in between the wooden cylinder and concave. The castor shellers are divided into hand operated and power operated. The hand operated machine does only shelling whereas the power operated machine does shelling, cleaning and sieving also.

Sugarcane crusher : It is a machine used to extract juice from sugarcane. Based on the power used, this is divided into hand operated, bullock operated and power operated crushers. In bullock operated machines, the rollers are fixed vertically whereas in hand and power operated machine, the rollers are fixed either horizontally or vertically. But horizontal fixing of rollers is most convenient for supplying power.

Maize sheller : It is a machine used to separate maize seeds from maize cobs. It is of two types based on power used (hand operated and power operated). Based on type of shelling mechanism, they are classified as (i) cylinder type and (ii) peg type.

Storage bin : Grain is generally stored in bags or in bulk. In villages bulk storage system is more common than the storage in bags. The bulk storage of grain in villages is generally done in one of the following structures in different regions of India.

—Bukhari type structure	—Made of mud or combination of mud and split bamboo

—Kothar type structure — Timber box placed on a raised platform

—Morai type structure — Made of timber, crop residue, metal sheets

—Cylindrical bin } —Made of sheet metal

—Rectangular bin }

2.3 Precautions:

—Arrange all available implements and tools operation wise.

—Support or provide proper jack to avoid accident hazard.

—Organise comparative study in operational technique of various implements.

2.4 Materials required :

i. Farm implement shed with collection of machinery

ii. Improved agricultural implements and selected hand tools.

iii. Plant protection equipment

iv. Water-lifting devices

v. Threshers, winnowers, chaff cutters

vi. Seed storage bins

2.5 Procedure :

—Arrange implements/machines securely in the shed in groups according to the functions.

—Study individual implement/machine with regards to its primary function, efficiency, power input required for operation, etc.

2.6 Observations .

The pupil should take the following observations given in the table below with regard to each available implement.

Sl. No.	*Name of the implement*	*Primary function*	*Efficiency prescribed by the manufacturer*	*Power in-put required*	*Design, shape and make of implement*	*Attachments to implement, if any and their proper alignment*	*Measure to improve efficiency*	*Movable parts if any and their proper assemblage*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*

2.7 Expected behavioural outcomes :

The pupil will be able to :

Grade

—identify farm implements for various operations;
—differentiate between implements having similar functions;
—select appropriate implement for specific operation;
—compare local and improved implements.

The teacher should evaluate the pupil for the above abilities.

2.8 Questions :

i. Give list of implements on the basis of tillage & power use.
   a) Tillage

b) Power

ii. Name the various implements used in different operations for locally grown crop (specify the crop).

iii. Which improved machine would you suggest for intercultivation of paddy, groundnut, wheat and jowar crops ?

iv. Name the different types of water lifting devices.

v. How does the implement used for wet land paddy preparation differ from the implement for dryland ?

3. Activity Unit

STUDY OF THE COUNTRY AND MOULD BOARD PLOUGH

3.1 Instructional objectives :

The pupil should be able to :

—know different parts of plough assembly;

– carry-out hitching and depth control ;

—adjust the critical dimensions of the plough ;

—know the steps required for good seed bed preparation.

3.2 Relevant information :

—*What is a plough ?*

Plough is the first and most important implement used for preparing the fields. It opens the field and makes the soil soft.

—*What is a country plough ?*

An indigenous plough is most common implement used by a farmer. It is made of wood and consists of body, shoe, share, beam and handle. The share is th e working part of the plough which penetrates into the soil and breaks the upper crust (Fig. 3.2.1).

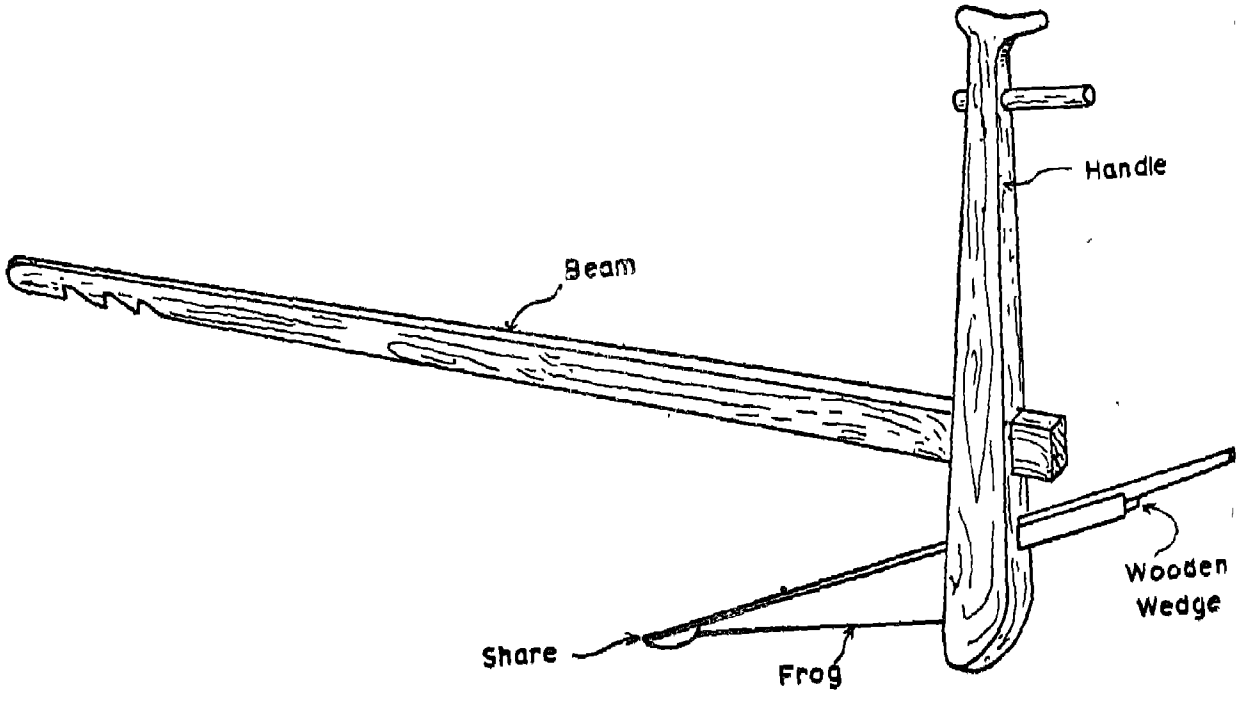


Fig. 3.2.1 Country Plough

—*How does a mould board plough perform its function ?*

In one operation the mould board plough (Fig. 3.2.2) inverts the soil, buries trash, weeds or green manure and granulates the soil, allowing air, water and tender roots of seedlings to penetrate easily.

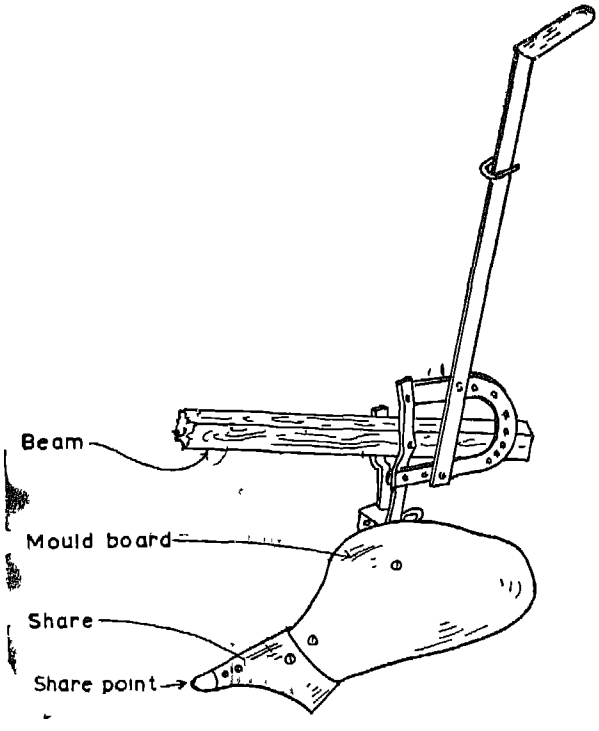


Fig. 3.2.2 Bullock Drawn Mould Board Plough

—*What affects the performance of a mould board plough ?*

Condition of the plough bottom and correct hitching of the plough to bullocks are the most important factors which affect the performance of mould board plough in the field.

—*What is a plough bottom ?*

The plough bottom consists of a share that penetrates into the soil and cuts the furrow slice. The mould board receives the furrow slice from the share and turns it over, placing it in the previous furrow. A landside has been provided to counteract the side pressure of cutting and soil turning. These three components are rigidly attached to the frog.

—*What makes the plough penetrate into ground ?*

The plough share and its vertical suction as shown in fig. 3.2.3 makes the plough penetrate into ground. The amount of this vertical suction can be measured as shown by placing the plough bottom upright on a flat surface. The gap should measure between 3 to 9 mm.

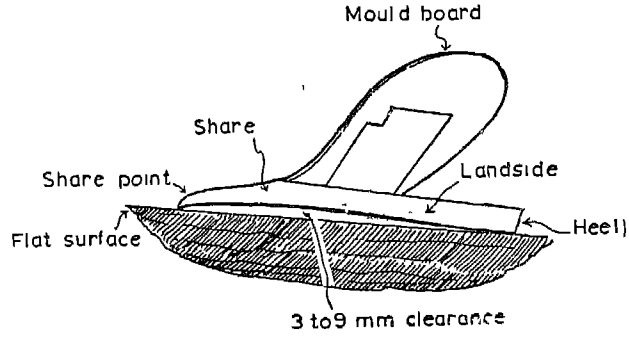


Fig. 3.2.3 Vertical Suction

—*How a plough maintains proper width of cut ?*

In a manner similar to vertical suction, the horizontal suction causes the plough to maintain a proper width of cut. It is

measured as shown in fig. 3.2.4 by placing the plough upright and laying a straight edge along the left side. The gap should measure 3 to 9 mm.

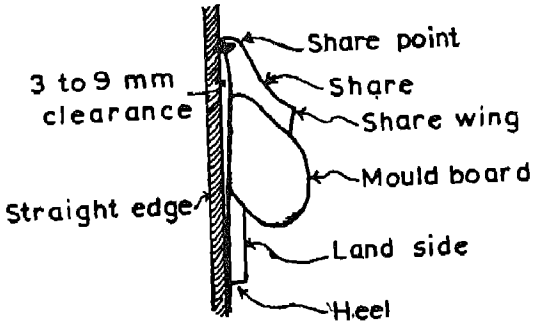


Fig 3.2 4 Horizontal Suction

—*What role does proper hitching play in good ploughing ?*

With a properly adjusted hitch the plough should maintain the desired width and depth of cut with only a very limited amount of guidance from the operator. The ideal method of hitching a pair of draft animals to a plough would be to have the centre of pull and centre of load resistance fall in the same line, parallel to the direction of travel. This line is called the line of pull. The centre of pull in this case is the mid-point of animal yoke, where the plough is fastened. The centre of load is a point on the plough bottom. This point is indicated as CL in fig. 3.2.5. The vertical line of pull should be straight (viewed from the side) extending from CL to the hitching point on the beam and to the centre of the yoke (See Fig. 3.2.5).

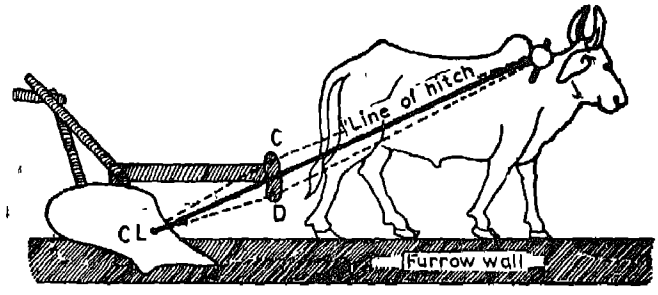


Fig. 3.2.5 Vertical Hitch Adjustment

—*What are ploughing methods ?*

There are three important methods of ploughing which are as under.

i. *Gathering* :

Whenever a plough works round a strip of ploughed land it is said to be 'gathering'. Ploughing of field by gathering alone is normally uneconomical. It leaves a dead furrow in the centre of the field.

ii. *Casting* :

Whenever a plough works round a strip of unploughed land, it is said to be 'casting'. Ploughing of a field by 'casting' alone is normally uneconomical. It leaves a back furrow at the centre of the field.

iii. *Continuous ploughing* :

In normal conditions, the continuous ploughing method is considered very convenient and economical. This is a method usually used in which the tractor and plough never run idle for more than three quarter land width along the

head land and never turn in a space narrower than a quarter land width. The dead furrows and back furrows by this method are 50% lesser than any other method of ploughing (See Fig. 3.2.6).

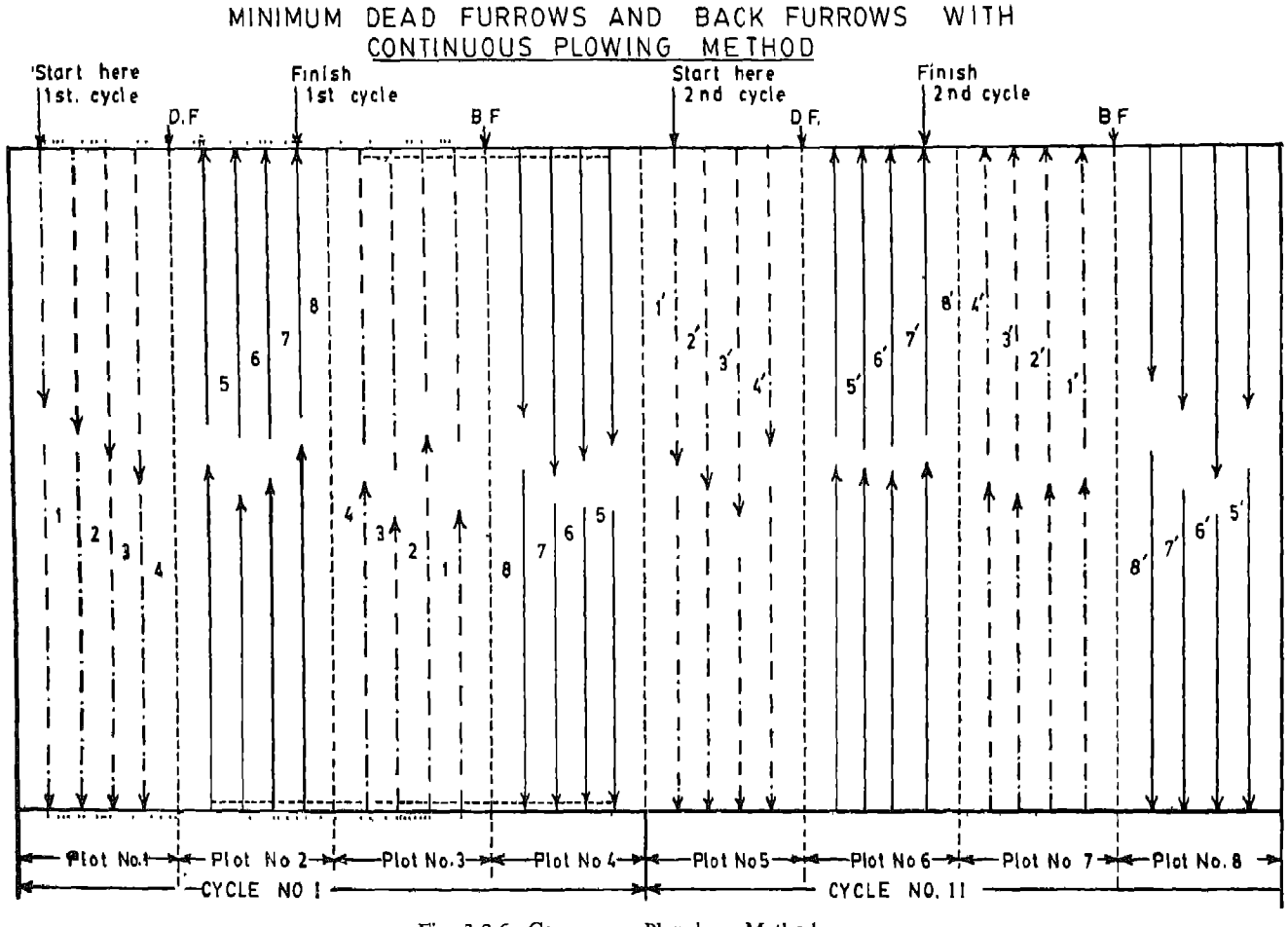


Fig. 3.2.6 Continuous Ploughing Method

—*What time is required to plough one hectare of land ?*

To calculate the time required for ploughing one hectare of land one needs to know the following :

a. Speed of walking (Bullocks) (S) m/hr

b. Width of cut (W) cm

Note : One hectare of land consists of 10,000 sq.m.

$$\text{Speed of walking Bullocks (S)} = \frac{\text{Distance covered by bullocks(m)}}{\text{Time in seconds to cover the distance}}$$

$$\text{Area covered} = \text{WXS sq.m/hr}$$

$$\text{Time required to plough one hectare} = \frac{10{,}000}{\text{WXS}} \text{ hrs}$$

Example :

A pair of bullocks covered a distance of

30 m in 60 seconds. These bullocks were used to pull a plough of 15 cm width. Find-out the time required to plough one hectare.

$$\text{Speed} = \frac{30}{60} \text{ m/sec}$$

$$= \frac{30}{60} \times \frac{60}{1} \times \frac{60}{1}$$

$$= 1800 \text{ m/hr}$$

$$\text{Area covered per hour} = \frac{15 \times 1800}{100} = 270 \text{ sq. m}$$

$$\text{Time required to plough one hectare} = \frac{10{,}000}{270} = 37.03 \text{ hrs}$$

At the field ends, some time is lost while making turns which may account for 15% losses. Therefore actual time required to plough one hectare

$$= \frac{37.03}{1} \times \frac{100}{(100\text{-}15)} = \frac{37.03 \times 100}{85}$$

$$= 43{\cdot}5 \text{ hours}$$

3.3 Precautions :

—Check tightness of all nuts and bolts each day before use and when in use.
—Keep the mould-board clean, shiny and smooth. Coat with old mobile oil or grease when the plough is not being used.
—Re-sharpen or reshape worn parts. This is particularly important in the case of share.
—Check tightness of all nuts and bolts of the plough.
—Check vertical clearance of the plough.
– Check horizontal clearance of the plough.

3.4 Materials required :

i. Bullocks ... 1 pair
ii. Yoke ... 1 No.
iii. Country plough/ Mould Board plough ... 1 No.
iv. Rope or chain
v. Spanner ... To fit plough nuts and bolts
vi. Stop watch ... 1 No.
vii. Measuring tape ... 30 m

3 5 Procedure :

—Put yoke on the neck of bullocks.
—Hitch plough with the pair of bullock through rope or chain.
—Adjust bend of the plough to get desired depth of ploughing.
—Check the line of ploughing.
—Mark a distance of 30 m on the ground with a measuring tape.
—Make the bullocks walk on the distance marked by you and note the time taken to cover the distance with stop watch.

3.6 Observations :

The pupil should take the following observations :

—Length of the field = ———— m

—Width of the field = ———— m

—Area of the field = ———— sq.m

—Speed of bullocks = ————m/sec

a) Distance marked on ground = ———— m

b) Time taken to cover the distance = ——————— sec.
(Repeat this observation and record the average time taken)

Calculations :

The pupil should calculate the speed of bullocks and area covered by bullocks in one hour.

a) Speed of bullocks = = X m/sec

Therefore per hour bullocks will walk $= \frac{X \times 60 \times 60}{1000}$ km/hr

=

=

= km/hr

b) Area covered by the bullocks in one hour = Width of cut in metre X Speed of bullocks in metre per hour

=

=

= = X sq.m/hr

Therefore one hectare of land can be ploughed in $= \frac{1}{X} \times 10{,}000 =$ hrs

= hrs

= hrs

3.7 Expected behavioural outcomes :

The pupil will be able to:

	Grade
—identify various types of ploughs and their components ;	
—measure the vertical and horizontal clearance ;	
—measure the speed of bullocks ;	
—hitch and operate the plough.	

The teacher should evaluate the pupil for the above abilities.

3.8 Questions :

i. What role does vertical clearance play ? It :

a) helps to increase width of cut. (Yes/No)

b) helps to decrease width of cut. (Yes/No)

c) helps to plough to obtain proper depth. (Yes/No)

d) helps to decrease the penetration depth, (Yes/No)

ii. Name the three components which are rigidly attached to the plough bottom.

_____

_____

_____

iii. Fill in the blanks.

a) The centre of pull is the————on the animal yoke.

b) The centre of load is an————on the plough bottom.

4. Activity Unit

BULLOCK DRAWN SEED DRILLS AND THEIR OPERATION

4.1 Instructional objectives :

The pupil should be able to :

—know different parts of seed drill ;

—adjust seed rate ;

—operate seed drill.

4.2 Relevant information :

—What are the functions of seed drill ?

Seed drills are used for planting seeds. They regulate accurately the amount of seed per hectare, plant at uniform depth, maintain row spacing and distance between the seeds, cover the seed well and compact it. The parts of a seed drill are as follows :

Frame : The frame is the base of a drill and all other parts are connected to it. The frame should be well braced and strong, as it must hold all parts in proper alignment.

Axles : The axles are attached to the under side of the frame and run the full length of frame. Suitable bearings are provided along the drill frame and power is taken to drive the seed metering mechanism. The bearings carry most of the machine weight and should always be kept well lubricated.

Wheels : Wheels are provided for forward motion. The wheels not only transport the machine but also are the source of power for driving the seeding mechanisms.

Seed box or hopper : The seed and fertilizer hoppers are carried on top of the frame and are usually made of wood.

Seed feeding device : Fluted force feed devices are most commonly used on the seed drills. The fluted roller consists of grooves on its surface which is in contact with seeds when they pass through the hopper. Grooves facilitate lifting of seeds as per the requirements.

Seed tubes : The seed tubes are commonly made of polyethylene. They are fitted at the bottom end of the hopper with a metal cup and carry seed straight way into the soil through furrow openers.

Furrow openers : The furrow openers open furrows of the desired depth, at the bottom of which the seed is dropped.

—*Calibration of seed drill* :

For accurate sowing, the seed drill (Fig. 4.2.1) should be calibrated before actually being used in the field. The calibration is done as follows :

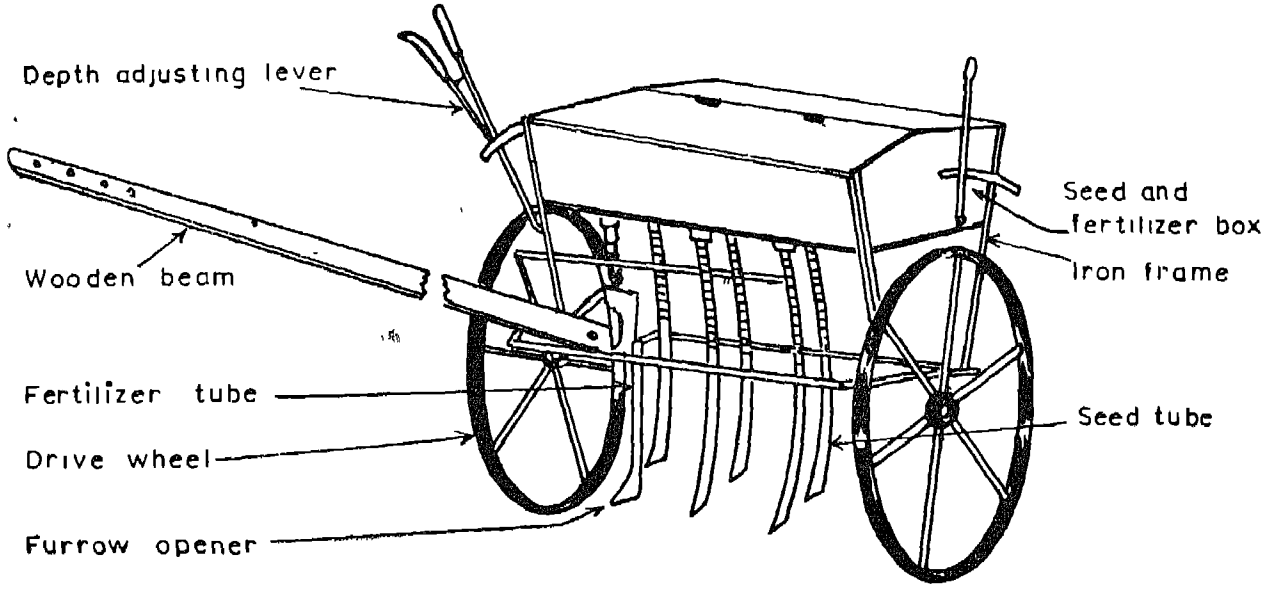


Fig. 4 2.1 Seed-cum-Fertilizer Drill

—Measure the circumference of the drive wheel. Suppose the circumference is 2.0 m.

—Measure the drilling width of the machine, say it is 1.0 m [There are 10,000 sq.m in a hectare. Dividing the area (10,000 sq.m) by the machine width, here it is 1.0 m. One has to drive $\frac{10,000}{1.0} = 10,000$ m to cover one hectare. To cover this distance the seed drill wheel will turn $\frac{10,000}{2.0} = 5,000$ turns i.e. to sow a hectare, the seed drill wheel will make 5,000 turns].

—Jack up the drill so that drive wheels are free from the floor. Place the grain to be sowed in the seed hopper or box.

—Determine the number of turns wheel will have to be rotated in 1/100 hectare. In this case it will be fifty turns. Give the drive wheel the required number of turns to plant 1/100 hectare.

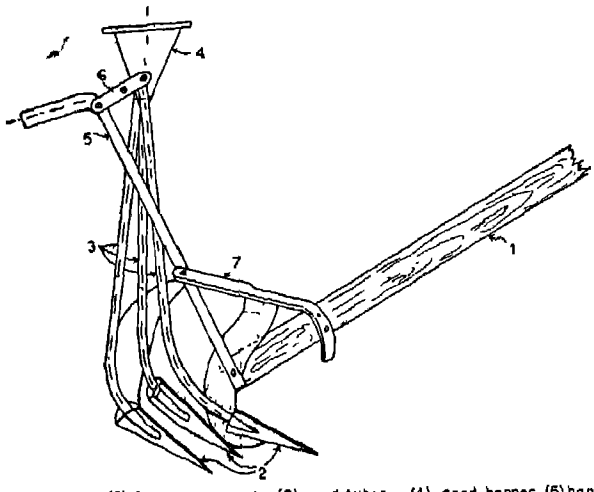
—Weigh the amount of seed collected below the furrow openers. Multiply by 100 to obtain seed rate per hectare.

—Push fluted roller in the seed box for more exposure with grain if increase in seed rate is desired or vice-versa.

—*Bullock drawn three tyne cultivator-cum-seed drill*

Seeding behind the plough is most commonly done in India. The three tyned cultiva-

tor with seeding attachment (Fig. 4.2.2) has also become very popular now in India.



(1) beam, (2) furrow openers, (3) seed tubes, (4) seed hopper, (5) handle (6) fixed bracket, (7) depth adjustment bracket

Fig 4.2.2 Three Tyned Cultivator with Seeding Attachment

4.3 Precautions :

—Grease or oil axle bearings.

—Grease or oil bearings of all other working parts.

—Clean grain hopper, fertilizer hopper and feed cups.

—Replace worn chains or gears.

—Adjust furrow openers.

—Paint metal and wood parts periodically.

4.4 Materials required :

i.	Pair of Bullock	One
ii.	Yoke	One
iii.	Seed drill	One
iv.	Seed (wheat or other grains)	Two kg
v.	Paper bags	One dozen
vi.	Grease Gun	One
vii.	Oil can and kerosene bottle	One
viii.	Weighing balance and wrench	One

4.5 Procedure :

—Squirt kerosene on the bearings of all parts of the feed shaft. Turn these shafts slightly with a wrench to make sure they are free.

—Lower the furrow openers and operate the machine idle for a few minutes.

—Hitch the drill to the yoke and see centre of pull and centre of resistance are in the same line.

—Fill the seed hoppers. The amount of seed to be used per hectare depends upon the type of crop to be sown in the field, climate, the fertility of the soil, the size of the seed and many other factors.

—Adjust the seed rate as explained earlier.

—Lower the furrow openers and start across the field, with the drill seeding just inside the space. Leave space at both ends. This is required for seed drill to take turns. This space is known as head land.

—After the main portion of the field has been seeded, the head lands be seeded.

4.6 Observations :

The pupil should take the following observations.

—Length of the field = m

—Width of the field = m

—Area of the field =

= Sq. m

—Diameter of the seed drill wheel = m

—Circumference of the wheel = m

= m

—Number of furrow openers =

—Spacing between the furrow openers = m

4.7 Calculations :

The pupil should calculate the number of turns for one hectare.

Results :

The seed drill meters accurately the seed and meters———kg of———seed per hectare.
(crop)

4.8 Expected behavioural outcomes :

The pupil will be able to :

	Grade
—identify various parts of the seed drill ; —adjust seed rate in the seed drill ; —operate the seed drill properly.	

The teacher should evaluate the pupil for the above abilities.

4.9 Questions :

i. List the functions of a seed drill.

ii. Fill in the blanks.

—The bearings carry most of the machine———— and should always be kept well————

—Wheels are provided for————

—Power for driving the seeding machanism is provided by the————

—Fluted roller consists of————on its surface.

iii. Write step by step procedure for seed rate adjustment in a seed drill.

iv. The diameter of a seed drill wheel is 1.5 m. Find out the circumference ?

v. How much time will a seed drill take to sow one hectare, if it has a width of 90 cm and wheel diameter is 1.5 m ?

5. Activity Unit

STUDY OF INTERCULTURE AND HARVESTING EQUIPMENT

5.1 Instructional objectives :

The pupil should be able to :

—identify various hand operated interculture tools and operate them in the field ;

—distinguish various animal powered interculture implements and operate them ;

5.2 Relevant information :

—*What is interculture ?*

Interculture is done after seeds emerge in the field. Interculture operation stirs and aerates the soil, uproots weeds, mulches the surface, does earthing, conserves more moisture, saves nutrients and makes the plant food more easily available.

—*When do we use hand tools for interculture?*

When the plants are young and distance between the rows does not allow the bullock operation.

—*Which hand tools are most commonly used?*

Following hand tools can be operated conveniently in standing position :

Hand hoe : This tool (Fig. 5.2.1), consists of a sharped mild steel shovel of V shape mounted on two bent iron bars and a wooden handle to operate it. It is operated by hand push and pull motion of the operator. It can be used for interculture of a crop in between and in the lines.

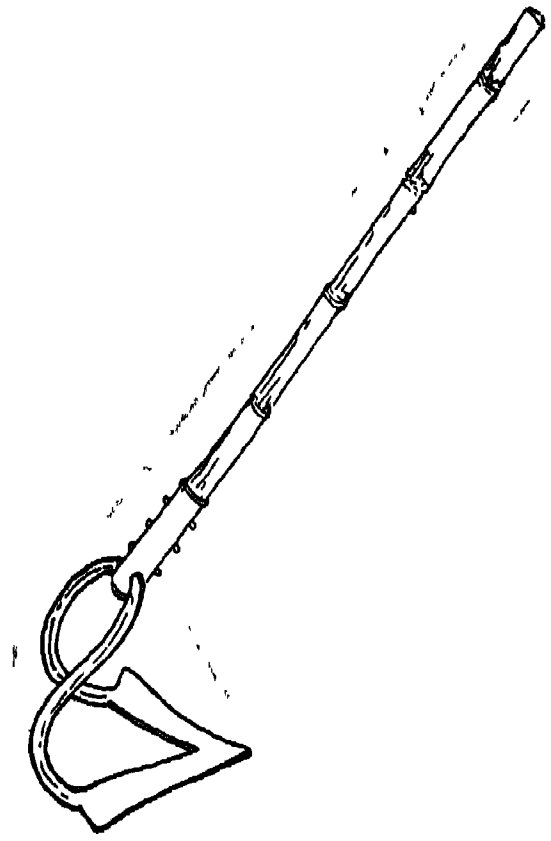


Fig. 5.2.1 Hand Hoe

Hand wheel hoe : The tool (Fig. 5.2.2) has the provision to attach various types of blades i.e. V blade, thriphali blade, cultivator shovel and the scraper blade for interculture in wheat, maize, groundnut and other row crops and vegetables. It is fitted with a wheel at the front which makes it easier to push and pull.

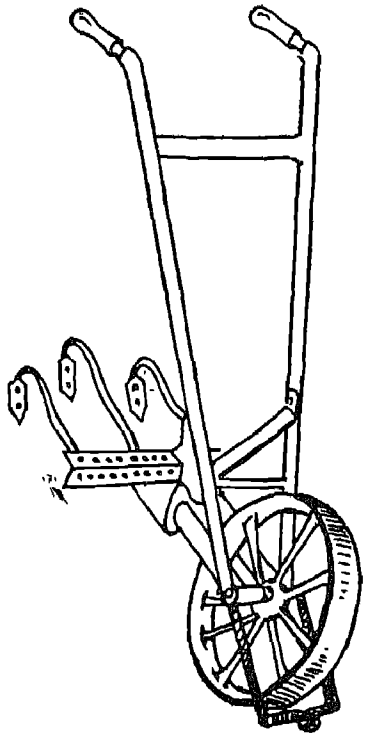


Fig. 5.2.2 Hand Wheel Hoe

Garden rake : It has got a number of teeth in shape of long nails (Fig. 5.2.3). It is mainly used for collecting straw and grasses from the field and mixing the seeds and fertilizers with the soil.

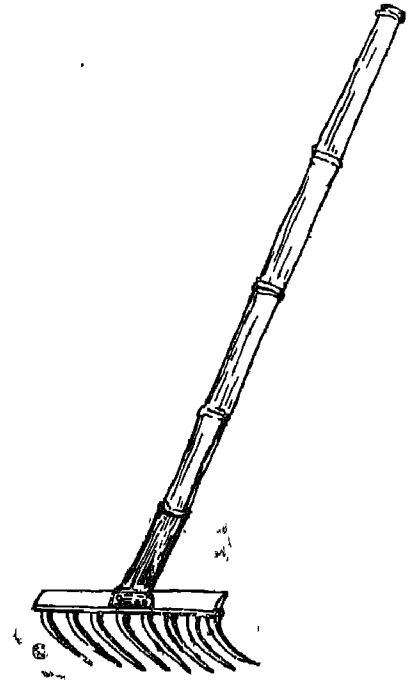


Fig. 5.2 3 Garden Rake

Paddy weeder : This hand tool (Fig. 5.2.4) is useful for paddy crop if transplanted in lines. The rotary tynes of the weeder dig and churn the soil, uproot and bury the weeds in the mud. Earthing of plants and good tillerage are also achieved. The metallic float helps in maintaining the working depth. Dryland weeders of similar design without float are available

for weeding in irrigated and dryland areas.

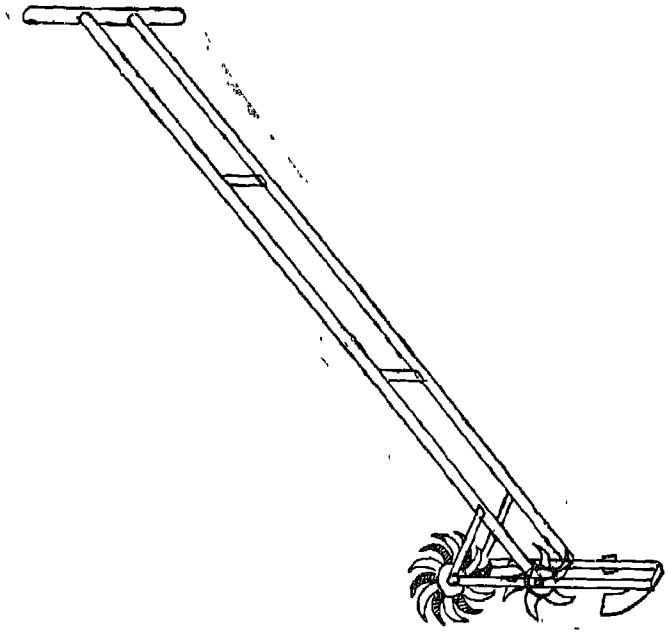


Fig 5.2.4 Paddy Weeder

—What are the implements which are pulled by bullocks to do interculture ?

Cultivator—5 tyned or 7 tyned
Ridger plough
Bund former
Green manure trampler
(Green manure trampler is used for trampling and burying the green manure exclusively in paddy field).

—What is the use of cultivator ?

Cultivators are used for tillage after the crop has grown. The cultivator stirs the soil very near the roots of growing crop. The cultivator is used mainly for eradicating weeds grown in rows such as of maize, cotton, potato, etc. Some of the cultivators have provision to expand and thereby change the spacing of weeding.

—What are different types of cultivator ?

Depending upon local conditions, different designs of 3-tyned, 5-tyned and 7-tyned cultivators have been developed (Fig. 5.2.5). Spacing between the tynes is adjustable to suit to various row crops. The tynes are staggered to prevent uprooting of crop plants.

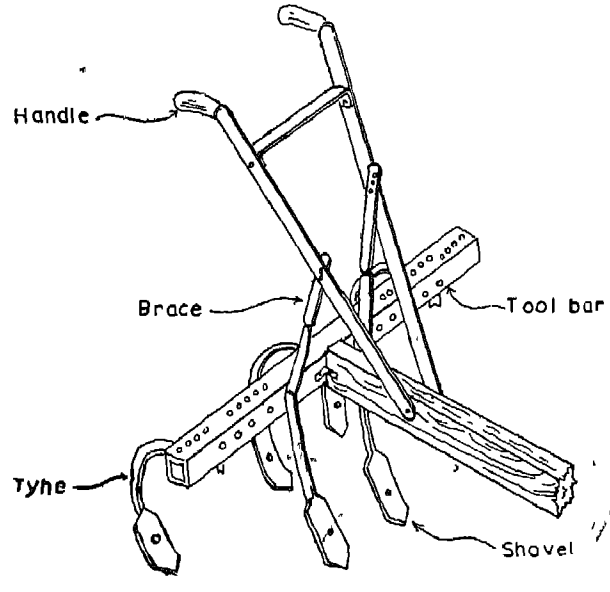


Fig. 5.2.5 Wah - Wah Cultivator

—What are different cultivating tools on cultivators ?

The cutting or working part is known as shovel. These shovels come in various designs to suit working conditions and

crop requirements. Figure 5.2.6 shows the various cultivating tools :

A & B — narrow single pointed shovels

C & D — double pointed reversible shovels

E & F — full sweep

G — mould board hiller (for potato field.

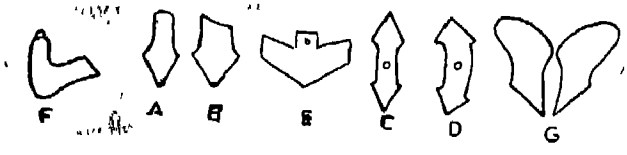


Fig. 5 2.6 Cultivating Tools Used on Cultivator

—*Can sowing be done with a cultivator ?*

Yes, since some of the shovel cultivators are also provided with seeding attachments. When it is used as a seed drill, only three or four shovels are provided with seeding spouts. A seeding funnel placed at the top-brace of handles is connected to the seeding spouts by means of conduit pipe. Necessary metering mechanism will have, however, to be provided or hand metering may have to be done very judiciously in traditional seed drills.

—*When and where ridger plough is used ?*

The implement is popularly used in sugar-cane growing regions. It makes furrows. Before using it the land should be first ploughed with ordinary plough (Fig. 5.2.7).

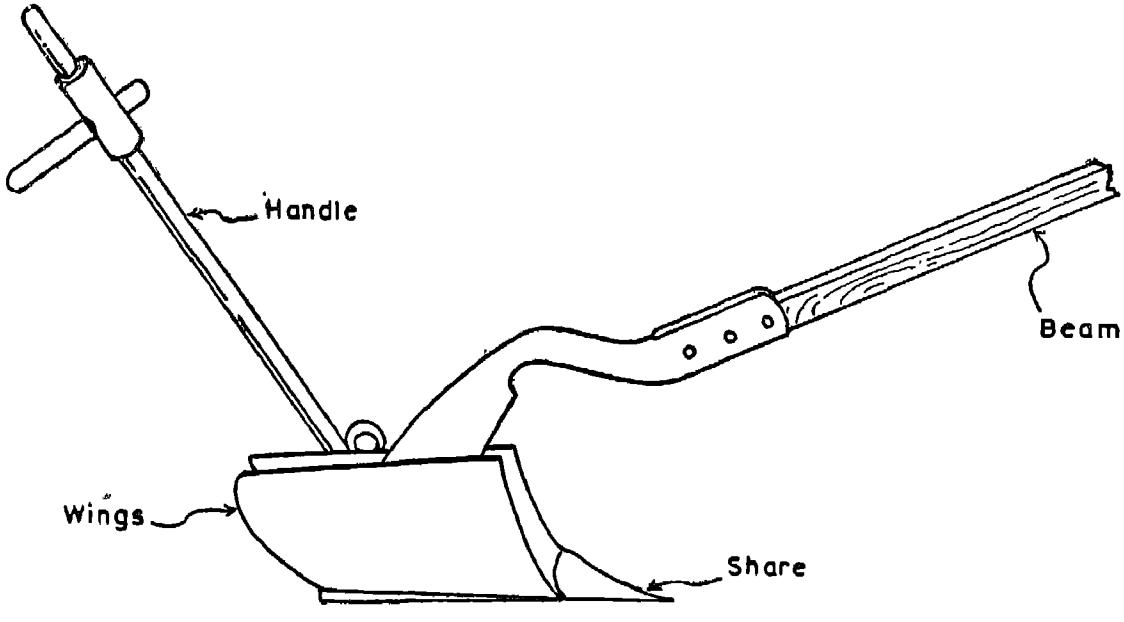


Fig. 5.2.7 Ridger Plough

—*What are the main components of ridger plough ?*

Ridger plough consists of the following main components :

i. Beam
ii. Wings
iii. Share

—*How do we make bunds in the field ?*

For making bunds in the field bund former (Fig. 5.2.8) is used. It consists of two moulds angled in such a way that they collect soil from front and leave a bund at the rear. The height of the bund is mainly dependent upon the operators pressure on the handle of bund former. The diverging configuration of the bund blades can be varied by changing the positions of the bolts and nuts.

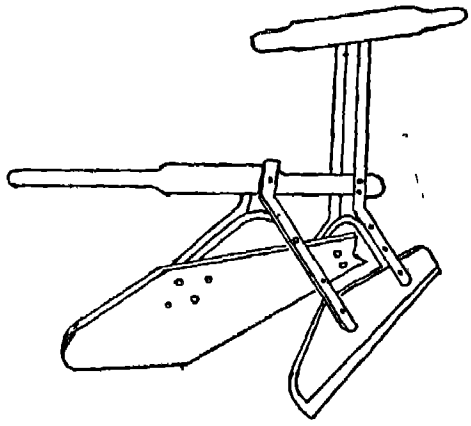


Fig. 5.2.8 Bund Former

—*What is the use of green manure trampler ?*

Green manuring is done by ploughing down green leguminous plants. Before ploughing the trampler (Fig. 5.2.9) having four discs is used. As the name indicates it chops the plants into smaller pieces so that when ploughing is done the incorporation of plants is proper. Some other designs have straight blades fastened to the periphery of four discs. They are sometimes called Burmese Sattan.

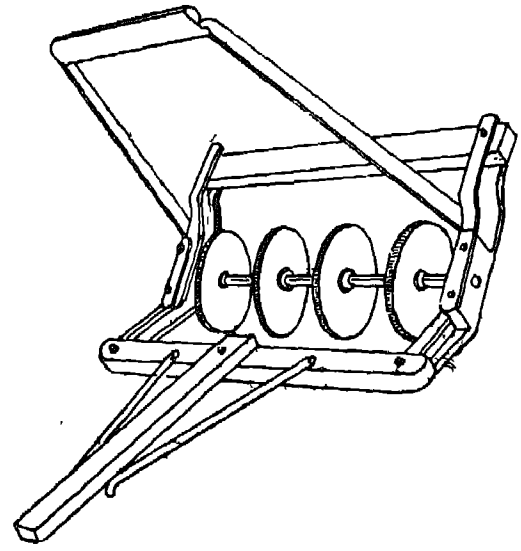


Fig. 5.2 9 Green Manure Trampler

—*How harvesting of crops is done and do we have some improved implements ?*

Harvesting in India is most commonly done with sickle (Fig. 5.2.10). Sickle is a traditional and very appropriate hand tool to cut crops. Any adult can shear the crop with its edge. Serrated edged sickles (Fig. 5.2.10) are more effective in cutting the plants in comparision with the smooth edged sickles.

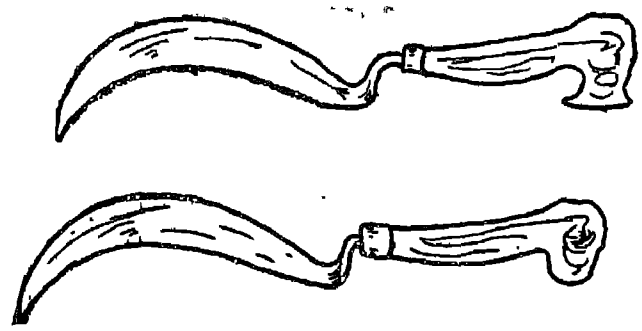


Fig. 5.2.10 Sickles

5a Sub Unit : Operation of a wheel hoe

5a. 1 Precautions :

—Lubricate all the working parts.
—Regulate depth of hoeing.
—Adjust leaf guards (if any).

5a. 2 Materials required :

i. Wheel hoe
ii. Measuring tape
iii. Spanners
iv. Lubricant

5a. 3 Procedure:

—Lubricate the wheels.
—See that the bolts which attach the tool holder to the handles are tight.
—Push forward the wheel hoe a few centimetres at a time.
—The depth of penetration is controlled by the amount of downward pressure the operator puts on the handles as well as by the inclination of the handle.
—Run the hoe to cover the operation in the field.

5a. 4 Observations :

The pupil should take the following observations :

—Area of the field

—Crop standing

—Name and number of plants on one metre square

—Area covered in one hour (After covering a large field)

5a. 5 Calculations :

The pupil should calculate how much time a man will take to operate wheel hoe in one hectare.

5b. Sub Unit : Operation of a cultivator.

5b. 1 Precautions :

—Space tynes to suit crop rows.
—Tighten all the nuts and bolts of the cultivator.

—Select suitable cultivating tools.

—Avoid operating too close to the standing crop.

5b. 2 Materials required :

i. Cultivator
ii. Hammer
iii. Spanner
iv. Measuring tape
v. Pair of bullocks with yoke
vi. Appropriate tools

5b. 3 Procedure :

—Select appropriate tools and fix them on the tynes.

—Hitch the cultivator with yoke and see that hitch line is straight with respect to the bottom of the tool.

—Take the cultivator to the field and adjust the tyne spacing as per the requirements of crop in the field.

—Give a try and operate it in the field. In case of uprooting of the crop plants, adjust the space between the tynes.

—Run the cultivator to complete the operation in the field.

5b. 4 Observations :

The pupil should take the following observations :

—Length of the field = m

—Width of the field = m

—Speed of the bullocks = m/sec

—Width of the cultivator = m

5b. 5 Calculations :

The pupil should calculate the time required to cover one hectare of land by the cultivator.

5.3 Expected behavioural outcomes :

The pupil will be able to :

—identify hand tools for interculture operation ;
—select appropriate hand tools for interculture ;
—operate wheel hoe ;
—operate cultivator.

Grade

The teacher should evaluate the pupil for the above ablilities.

5.4 Questions :

i. Fill in the blanks :

Interculture operation– – – –and– – the soil.

Interculture operation– – – –weeds.

Interculture operation– – – –the surface.

ii. List the cultivating tools attached to the cultivator.

_____

_____

_____

_____

_____

iii. Why cultivators are used in row crops ?

_____

_____

_____

_____

_____

_____

6. Activity Unit

OPERATION AND MAINTENANCE OF PLANT PROTECTION EQUIPMENT

6.1. Instructional objectives :

The pupil should be able to :

—identify various types of plant protection equipment ;

—correct minor defects and do minor repairs during emergency ;

—choose the suitable appliance for a particular operation ;

—use different types of sprayers and dusters for different crops.

6.2 Relevant information :

Different kinds of spraying and dusting machines are available to meet the requirements in controlling insects, diseases and weeds (Fig. 6.2.1).

—*Why do we use plant protection equipment* ?

For protecting the plants from various injurious organisms the chemicals need to be applied on the plant surface in the form of sprays, dusts, etc.

—*How plant protection machines are classified ?*

They are classified on the basis of source of energy for operation.

a) Hand operated machines—suitable for small holdings. They are operated at pressure ranging from 1 to 7 kg/sq. cm.

b) Power operated machines—suitable for treating a large area. They are operated at pressures from 20-55 kg/sq. cm.

—*How many types of hand operated sprayers are available ?*

There are three types of hand operated sprayers :

i. Bucket type sprayers
ii. Knapsack sprayers
iii. Compression sprayers

—*Working of sprayers*

Fungicide/insecticide solution is pumped under high pressure through a delivery tube terminating in a nozzle and dispersed in the form of minute particles. An area of half to one hectare can be sprayed in a day By a foot sprayer 1.5 to 2 hectares and by a power sprayer at a pressure of 55 kg/sq. cm an area of 50 to 100 hectare can be sprayed in a day.

—*How many types of dusters are available in the market* ?

There are four types of dusters which are available in the market ·

i. Plunger duster
ii. Bellow duster
iii. Hand rotary duster
iv. Power duster

—*How a duster works ?*

The fungicide dust is drawn by means of air current produced by air pressure developed by the rotary fan and discharged out through the delivery hose terminating in a nozzle. An area of 1—2 hectare per day may be covered by a hand rotary dus-

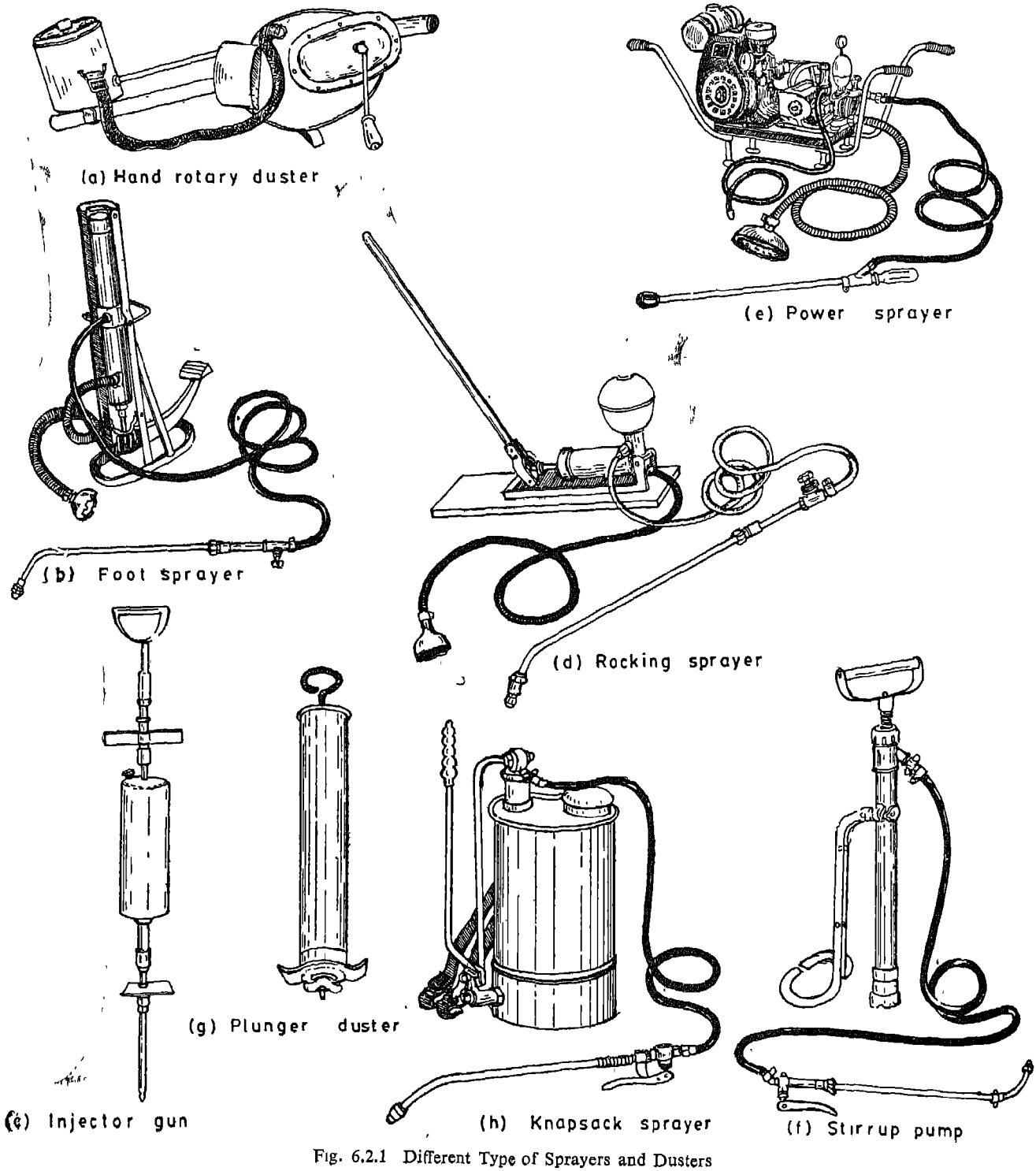


Fig. 6.2.1 Different Type of Sprayers and Dusters

ter and 14—18 hectares/day by a power duster.

—*What are various types of nozzels available for sprayers ?*

There are four types of nozzels which are available for use :

i. Ring type
ii. Hollow cone
iii. Disc type
iv. Solid cone

Two or more nozzels may be combined into a single hose in order to increase the efficiency in spraying. The nozzle hole of 0.3—1.0 mm in diameter is provided for all types of sprayers.

—*What is the use of soil injector ?*

It is used for applying fumigating chemicals like chloropicrin, methyl bromide, formaldehyde in the deeper (10—15 cm) layer of soil. They are for localized application.

—*What care and maintenance is essential for sprayers and dusters ?*

Follow the instructions of the manufacturer for maintenance and upkeep of equipment especially with regard to lubrication and working conditions.

Clean all machines properly and store them in dry place.

Drain the tank of a sprayer and flush it with clean water; wash the pump, nozzle, strainer, lance, hose etc. Run clean water through pump, hose and nozzle, before and after use.

Empty dust from the hopper of the duster and clean with cloth.

Overhaul the machines regularly and replace the worn-out parts. Grease and oil the moving parts, especially the cylinder, piston assembly, washers, valves, agitator shaft, bearings, plunger, packings and other parts likely to go dry when not in use.

Do not bend rubber hose at acute angles when in use. At the end of season, clean the sprayer thoroughly. Drain all water from engine, pump, tank; disconnect hose and run lubricating oil through the pump only ; lubricate all external parts. Drain oil from engine and pump and replace with new oil.

Do not throw nozzles of syrayers and delivery tubes of dusters on bare ground. Always keep spare parts and a tool kit. Filter spray liquid and shake the dust to avoid clogging of the nozzle and the delivery tubes.

Test pressure regulator and pressure gauge occasionally for their efficiency.

—*What are important spraying techniques ?*

The spraying techniques are often classified as under :

a) High volume—more than 400 litres of spray liquid per hectare is used

b) Low volume—spray volume ranges between 5 and 400 litres per hectare.

c) Ultra—low volume (ULV)—all techniques in which less than 5 litre per hectare is applied.

—*High volume spraying*

High volume spraying is done by hydraulic machines and these machines use dilute solutions The technique is biologically more effective, but economically expensive in time and labour.

—*Low volume spraying*

Low volume spraying using air stream from a fan as a pesticide carrier with

small quantities of liquid have been developed to reduce the cost. Twenty five per cent less spray material is required per hectare in addition to saving in labour.

—*Ultra-low volume spraying*

ULV spraying can be defined as plant protection operation in which the total volume of liquid applied amounts to a few millilitre per hectare. The recent introduction of the hand-held spinning-disc sprayer is used for ULV applications and used mostly where water is scarce.

6.3 Precautions :

—Follow the instructions while using sprayer and duster.

—Do not alter the set up of different parts of the equipment until you are quite sure about their repair.

—Remove the air pressure completely before you open any part of a sprayer.

—Go on making a list of parts of the equipment when it is dissembled. Keep all parts groupwise seperately and fit them again in the same order.

6.4 Materials required :

i.	Knap sack sprayer	— one
ii.	Hand rotary duster	— one
iii.	Spanners	— one set
iv.	Screw driver	— one
v.	Bucket	— one
vi.	Grease	0.10 kg
vii.	Lubricating oil	0.10 litre
viii.	Oil can	— one
ix.	Any Dust	— 2 kg
x.	Water (Spray liquid)	— 4 litre

6.5, Procedure :

—Check different parts of the equipment.

—Open the filling cap and check the gaskit.

—Descrew to open the pump barrel and check leather washer of the pump and air valve in the bottom of the barrel. Replace the valve if the air is leaking through it.

—Open the delivery tube, metal lance and nozzle. Clean them if there is any obstruction or clogging.

—Fit all accessories again in the same order in which they were opened ; tighten them perfectly.

—Mark an area say 100 sq.m for spraying/dusting.

—Test the working of the equipment after filling measured quantity of water in the sprayer and dust in the duster.

6.6 Observations :

The pupil should take and record the following observations :

—Air pressure in the pressure gauge provided on the top side of the sprayer.

—The spray and dust coming out of nozzle and note whether it is proper.

6.7 Calculations :

The pupil should calculate the amout of spray liquids/dust required to spray/dust the plot.

6.8 Expected behavioural outcomes :

The pupil will be able to :

Grade

—know the parts of sprayer and duster ;

—assemble and clean different assemblies of the equipment ;

—use the suitable equipment for a particular type of job ;

—operate the sprayer and duster in proper manners.

The teacher should evaluate the pupil for the above abilities.

6.9 Questions :

i. Name different types of sprayers and dusters.

ii. Write four important hints for maintenance and upkeep of sprayer and duster.

iii. What will you do if the lance and nozzle of a sprayer are clogged while spraying ?

iv. Fill in the blanks :

a) High volume sprayer sprays more than————litres of spray liquid per hectare.

b) Low volume sprayer discharge between————and————litres per hectare.

c) Ultra low volume (ULV) sprayer applies less than————litres per hectare.

7. Activity Unit

•INSTALLATION, OPERATION AND MAINTENANCE OF CENTRIFUGAL PUMP

7.1 Instructional objectives:

The pupil should be able to :

—know the function of a pump and various types of pumps available for irrigation ;

— install a centrifugal pump;

—operate a centrifugal pump;

—maintain a centrifugal pump;

—attend to trouble shooting.

7.2 Relevant information :

—*Why use a pump for irrigation* ?

—To lift more water in less time.

—To reduce the cost of irrigation.

—To reduce the drudgery on part of the farmer.

—*What are the different types of pumps available for irrigation* ?

Several types of pumps are available to meet the needs of irrigation. These include :

i. Centrifugal pump (Volute type)

ii. Turbine pump
iii. Submersible pump } Deep well pumps

Centrifugal pump : The Centrifugal pumps are the most commonly used pumps because these are suitable over wide range of operating conditions, though these are limited to suction lifts of 5-6 metres. They are also preferred because of their low cost, higher efficiency at lower heads, simple construction, easy installation, operation and maintenance.

—*What are the different parts of a centrifugal pumping set and how it functions* ?

A centrifugal pumping set consists of :

a) Motor or engine unit

b) Pump unit

Motor or engine unit : Motor or engine unit supplies energy to the pump to run it and it is connected to the pump by a belt or through a shaft.

Pump unit : It consists of the following components (Fig. 7.2.1).

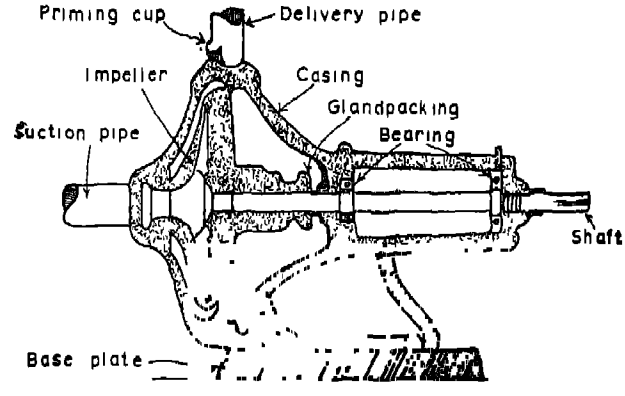


Fig. 7.2.1 Internal Section of a Centrifugal Pump

Impeller : This is an important working part of the pump. It helps in lifting the water.

Casing : This is second important part of a pump. It guides the direction of flow of water in the pump.

Stuffing box : It works as a sealing between the pump and pumping shaft. For preventing the leakage of water from the

casing or restricting entry of air into the casing, a gland packing is put in the stuffing box.

Bed plate : It provides a necessary base for holding the pump and motor or engine unit.

Foot valve assembly : It consists of a valve and strainer and allows the water to flow in one direction only (from water source to pump).

—*What are the various troubles which one can come across while operating a centrifugal pump and what are their remedies* ?

CENTRIFUGAL PUMP TROUBLES AND THEIR REMEDIES

Sl. No.	Cause	Remedy
	Pump Stops Delivering Water While Working	
i.	Air leaks through the gland.	Tighten the gland.
ii.	Air leaks through the flange or some joint in the suction line.	Locate the leak in the suction line and remove the cause of the leak.
iii.	Impeller is choked up with foreign matter.	Remove the foreign matter.
iv.	Foot valve strainer choked up with rubbish.	Clean the foot valve.
v.	Water level gone down below practical suction lift.	Wait till the water rises or lower the pump within the practical suction lift.
	Pump Takes Too Much Power	
i.	The bearings are running hot.	a) See that the lubrication is properly given. b) See that the foundation is sound.
ii.	Wrong direction of rotation	Check for the direction of arrow mark on the casing.
iii.	Vibration in pump	a) Use correct foundation for rigidity. b) Check for pump misalignment. c) Check for bent shaft.
	Pump Does Not Deliver Water At The First Start	
i.	Lack of prime	Fill the pump and its suction pipe completely with water. Leave the vents open until clear bubble-free liquid flows from them. Close the vents and start the pump.
ii.	Wrong direction of rotation.	See that the pump turns in the direction of the arrow on its casing.
iii.	Air leaks in gland.	Tighten the gland.
iv.	Air leaks in suction pipe.	Tighten the suction pipe.
v.	Water leaks through foot valve or suction or gland and pump does not keep-up priming.	Check up the foot valve.
	Not Enough Water Delivered	
i.	Impeller or suction pipe or opening partially plugged up.	Remove the foreign matter causing plugging.

ii. Wrong direction of rotation.	Correct the direction of rotation in the direction of arrow mark on its casing.
iii. Air pocket in suction line.	a) Remove air pocket by filling the pump and suction pipe completely by water. Leave the vents open until clear bubble-free water flows from them; close the vents and start the pump.
	b) Check the pump's stuffing box and adjust the gland to give the suitable flow from the box.
iv. Mechanical defects :	Remove mechanical defects :
a) Bearings worn out.	a) Replace all worn out parts during a pump over haul.
b) Impeller damaged.	b) Repair or replace the damaged impeller.
c) Casing packing defective.	c) Make the casing packing properly effective.

Pump Is Noisy

i. Mechanical defects :	Remove mechanical defects :
a) Shaft bent	a) Replace the shaft if necessary.
b) Rotating parts are loose or broken.	b) Check for loose and broken parts, replace the broken parts and tighten the loose ones.
c) Bearings worn out.	c) Replace the bearings.
d) Pump and driving units misaligned.	d) Make the proper alignment of pump and driving unit.
ii. Foundation is not rigid.	Use correct foundation for rigidity.

Pump Does Not Start

i. Impeller locked.	Remove the sand or any other cause of locking.
ii. Trash in casing.	Remove the obstruction and fit the suction with strainer to keep trash out of the pump.
iii. Corrosion or growths in case of pumps out of service for long period.	Remove corroded matter or growths from the pump by using acid or other recommended chemicals.

7.3 Precautions :

—Try to install the pumping set as close to the surface of water as possible.

—See that the distance (vertical height) between the stationary water level and centre of the pump does not exceed 5-6 metres.

—Submerge the foot valve which is attached on the lower end of the suction pipe in water at least 1·5 metre deep.

—Protect the pump against submergence in

water and if it is a motor driven unit, it should be located at a dry place

—Place the pump in an accessible place to enable frequent inspection and lubrication during operation.

—See that the electric motor pumpsets are fitted with voltage stabilizer to avoid burning of electric motor field coils due to fluctuations in the voltage.

7.4 Materials required :

i. Centrifugal pump, electric motor or diesel oil or petrol engine, gland packing, suction pipe with foot valve, delivery pipe with a sluice valve, starter for electrical motor, cable.

ii. Cement, sand, aggregate.

iii. Bolts, nuts, pipe sleeve, washers, shims.

iv. Pipe wrench, chain wrench, spanner set, spirit level, water bucket, straight edge.

7.5 Procedure :

—Embed the proper size of bolts in concrete. Use pipe sleeve about $2\frac{1}{2}$ times larger in diameter than the bolt to allow movement for the final positioning of the bolts. If the pump and its driver are mounted on a common base plate, the unit should be placed in position with wedges under each corner of the base plate close to the foundation bolts. The wedges can be adjusted when necessary to bring the pump into a level position. Any misalignment may be corrected by placing shims (thin washers) under the pump (See Figure 7.5.1).

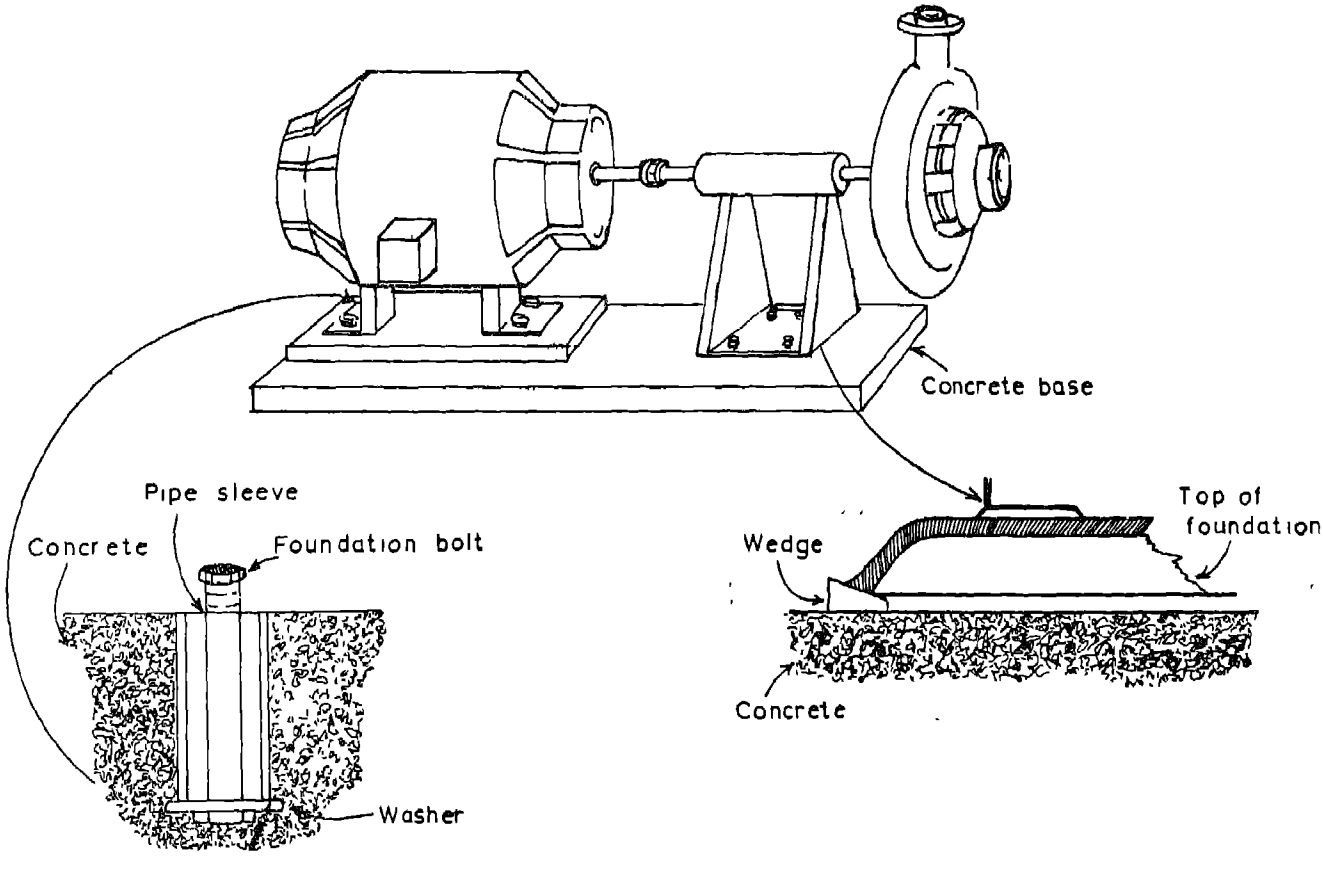


Fig. 7.5.1 Use of Wedges in Installation of Pump

—Check alignment of the coupling between the pump and power unit with a steel edge. See figure 7.5.2 for checking alignment.

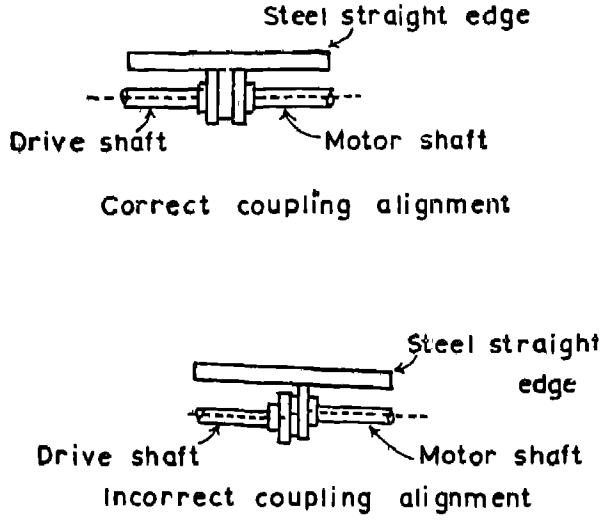


Fig. 7.5.2 Coupling Alignment

—Check the rotation of the motor. The rotation of the motor must be in the same direction as the arrow on the pump casing.

—In case water level in the well is more than six metres, locate the pump within the well to the suction lift within six metres. In case of motor driven pumps, both the pump and motor should be inside the well as shown in figure 7.5.3.

—Remove air from the suction line and the casing.

—Fill the priming cup fixed on the casing with water to remove air in the pipe line. As the air is removed water rises in the suction pipe to take its place.

—After filling the water in the casing, close the delivery valve and start the motor or engine. Open the delivery valve slowly.

—For continuous trouble-free operation check once in a month by hand, whether shaft rotates easily.

—Check pump and driver alignment and correct it, if necessary, periodically.

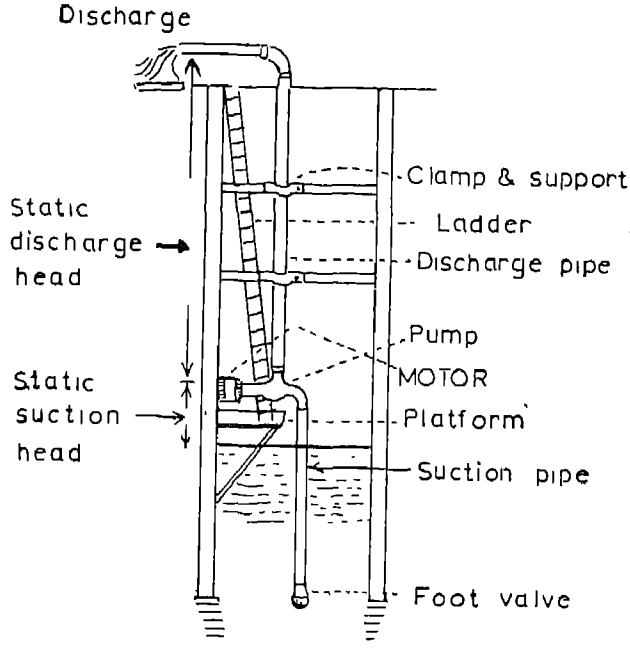


Fig. 7.5 3 Installation of a Motor Driven Centrifugal Pump in an Open Well

—Clean and oil the gland, bolt and nuts periodically.

—Inspect the gland packing. If worn out, replace it periodically.

—Drain/and refill, oil lubricated bearings, as and when needed.

—Check and correct the amount of grease in grease lubricated bearings, as and when needed.

—Thoroughly inspect the unit once a year for scratches and wear on shafts. Disconnect coupling halves and check their alignment.

—Remove bearings once a year, inspect and replace, if necessary.

—Inspect once a year the impeller and casing for wear.

7.6 Observations :

The pupil should take and record the following observations.

i. Diameter of the well = ... m
ii. Depth of water in the well = ... m
iii. Diameter of delivery pipe = ... cm
iv. Diameter of suction pipe = ... cm
v. Rotation of the pump shaft = ... Clockwise/ Anticlockwise
vi. Observe the horse power rating on motor = ... hp

7.7 Expected behavioural outcomes :

The pupil will be able to :

—identify pumps available for irrigation ;
—install a centrifugal pump ;
—operate a centrifugal pump ;
—maintain a centrifugal pump ;
—attend to the trouble shooting

Grade

The teacher should evaluate the pupil for the above abilities.

7.8 Questions :

i. Name the different types of pumps available for irrigation.

ii. What is the function of a casing in a centrifugal pump ?

iii. What is the function of a foot valve ?

iv. What is the maximum depth from which centrifugal pump can lift water ?

8 Activity Unit

OPERATION, MAINTENANCE AND SAFETY MEASURES OF THRESHERS

8.1 Instructional objectives :

The pupil should be able to :

—know the function of a thresher;

—know about the different types of threshers commonly used;

—select a suitable site for threshing;

—install a thresher properly ;

—operate a thresher;

—maintain a thresher;

—take appropriate safety measures;

—take measures for proper off-season storage of threshers.

8.2 Relevant information :

—*What is threshing* ?

Threshing is the removal of grains from the harvested plants.

—*What are traditional methods of threshing* ?

Traditionally threshing is accomplished by striking a bunch of plants on a hard surface or trampling the spreaded crop under the feet of bullocks by making them walk over them again and again till grains are removed from the plants.

—*Why use a machine for threshing* ?

It accomplishes the job of threshing in a lesser time, gives clean grain, makes bhusa, resulting thereby in saving of farmer's time and energy, which could successfully be then used for preparing fields for the next sowings well in time.

—*What are the different type of threshers* ?

Threshers can be classified on the basis of the source of power they utilise for their operation. Those pulled by a pair of bullocks are bullock operated threshers, example olpad thresher.

Those operated manually are foot or pedal operated threshers. These do not make bhusa. Bhusa is the end product of cut pieces derived during the process of threshing.

Those which are run by a motor, engine or tractor power-take-off shaft pulley are power operated threshers and are generally of high capacity and can also discharge clean grain and make bhusa.

—*What are the main parts of a threshing machine* ?

From the figure 8.2.1 it can be seen that a thresher essentially consists of cylinder concave assembly in which removal of grain from the plants takes place, a feeding trough through which crop is fed into the thresher, blower fan assembly which sends air for blowing off the bhusa, a sieve assembly which screens good grain. Power is transmitted from an electric motor or an engine by a flat belt which runs over the thresher pulley which

in turn rotates the different components of the thresher.

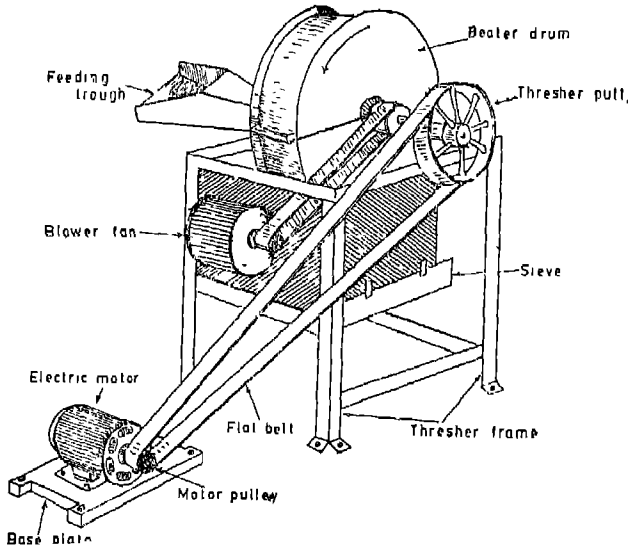


Fig. 8 2 1 Thresher

—*What are the different recommended cylinder speeds for various crops ?*

Following cylinder speeds are given for guidance in respect of different crops :

Sl. No.	*Crop*	*Cylinder speed (Revolution per minute*
1.	Wheat	550-1100
2.	Barley	740-1080
3.	Paddy	675-1000
4.	Bajra	400-550
5.	Jowar	400-675
6.	Gram	400-750
7.	Peas	430-750

—*What is the method of determining the size of pulley to be used on a thresher ?*

Following formula is used for calculating the size of a pulley :

$$D_T = \frac{D_P \times N_P}{N_T}$$

Where : D_T = Diameter of thresher pulley to be calculated in, mm

N_T = Revolutions per minute of thresher pulley

D_P = Diameter of motor or engine pulley, mm

N_P = Revolutions per minute of motor or engine pulley

To illustrate the use of this formula, an example is solved below :

Determine the size of pulley to be installed on a thresher whose speed is 1000 revolutions per minute which is operated by an electric motor whose speed is 1440 revolutions per minute and the size of its pulley is 100 mm.

Solution :

Apply the formula

$$D_T = \frac{D_P \times N_P}{N_T} \quad \ldots\ldots\ldots\ldots (1)$$

Here = D_P = 100 mm

N_P = 1440 rpm

N_T = 1000 rpm

Put the value in ..... (1)

$$D_T = \frac{100 \times 1440}{1000}$$

$$= 144 \text{ mm}$$

The size of the thresher pulley is 144 mm

8.3 Precautions :

—Do not wear loose dress or bangles while working on a thresher.

—Do not smoke or light fire near a thresher.

—Never operate thresher under the influence of intoxicants.

—Get swap to the operators more often to reduce fatigue.

—Undertake any kind of repair only after stopping the machine.

—Do not stand on the body of the thresher while working or transporting it.

—All the moving parts like pulleys and belts should be properly guarded with shields.

—Do not cross over the moving flat belt.

—Keep the minimum upper cover length of the feeding trough to 450 mm.

—See that the thresher and power units are firmly grounded to curtail vibrations and to check over-turning and misalignment.

—Maintain proper cylinder concave clearance as per instructional manual supplied by the manufacturer.

—Do not feed ear heads and short stalked crops by hand alone. Use stick for feeding.

—Feed the crop as evenly as possible.

—Never take the hand very far inside the feeding trough while feeding the crop.

—Keep sufficient sand and water to extinguish the fire, if it occurs.

8.4 Materials required :

i. Thresher with pulley
ii. Electrical motor or engine or tractor with pulley
iii. Iron pegs for grounding the motor or engine and thresher
iv. Bench or a suitable platform for operator to stand
v. Crop to be threshed
vi. Sand and water for fire extinguishing
vii. Plastic or tarpaulin sheet
viii. Kerosene, Grease, Mobil oil.

8.5 Procedure :

—Select a threshing site as far as possible away from the residential area. It should not be near a railway line or under a power transmission line. Although there should be no obstruction, but some kind of shade for the operator should be available.

—Notice the direction of wind and orient the thresher in such a way that the bhusa is blown with the wind and not against the wind.

—Level the thresher both laterally and longitudinally.

—In the case of mobile thresher firmly ground the thresher wheels by putting wheels in shallow ditches and driving iron pegs over them to avoid movement of the machine.

—Check the alignment of the thresher with the power source and also firmly ground the power source at a distance where the blown straw does not fall over it.

—After having firmly grounded the machine, move the pulley with hand to see if there is any obstruction in the movement of the cylinder.

—Put the belt over the pulleys and check tension.

—Start the operation of thresher and run it idle for some time. Notice whether cylinder is rotating in the direction marked on the body of the thresher.

—Start feeding of crop through the feeding trough and collect grain at the bottom towards the opposite end.

—From time to time tighten all nuts and bolts.

—Clean, oil and grease all the lubricating points.

—Occasionally check the sieves and clean if opening are clogged.

—At the end of the threshing season, run the thresher idle for some time so that all the left over material comes out.

—Remove by hand all the bhusa and grain that might have been left over,

—Remove all the belts, clean and store them at a proper place.

—Wash the thresher. Dry and clean the thresher.

—Examine all the parts of the thresher and replace the worn out parts.

—Remove the sieves, clean them and apply used mobil oil to avoid rusting.

—Paint the thresher periodically and whenever necessary. Apply grease and used mobil oil to avoid rusting.

—Clean the lubricating points especially grease cups with kerosene oil and apply grease.

—Remove the thresher from the yard and store it under a shed, so that rain water does not fall over it. If there is no roof, cover it with a plastic or tarpaulin sheet.

8.6 Observations :

The pupil should take the following observations :

i. Observe the direction of cylinder rotation ... Clockwise/ Anticlockwise

ii. Measure the diameter of thresher pulley ... = cm

iii. Take random samples of 100 grains from the threshed material and count the number of broken or damaged grains.

iv. Locate all the oiling points i.e. locations.

v. Locate all the greasing points i.e. locations.

vi. Take threshed material and find the rested grains in the straw, if any.

8.7 Expected behavioural outcomes :

The pupil will be able to :

—install a thresher at a proper threshing site ;

—operate a thresher ;

—maintain a thresher ;

—adapt proper safety measures in operation and maintenance.

Grade

The teacher should evaluate the pupil for the above abilities.

8.8 Questions :

i. Why threshing by machine is preferred over conventional threshing ?

_____

_____

_____

_____

Percent

ii. What is the name of the component which sends the air for blowing bhusa ?

iii. What is the recommended cylinder speed for wheat crop ?

iv. From a motor having a speed 1440 rpm, it is desired to transmit the power to a thresher whose rpm are to be maintained at 820 and the pulley fixed in it is of 15 cm diameter. What should be the size of the pulley of the motor ?

v. Why it is necessary to firmly ground the thresher wheels before starting operation ?

vi. Why sand and water are required near the threshing floor ?

9. Activity Unit

OPERATION AND MAINTENANCE OF WINNOWERS

9.1 Instructional objectives :

The pupil should be able to :

—know various types of winnowers ;

—understand operational technique of the machine ;

—identify different parts of the machines and their functions ;

—handle actual operation of the machine.

9.2 Relevant information :

Winnowing with the help of natural wind velocity is a common practice in the country, but it involves additional man power and is also time consuming when natural wind velocity is not adequate. Therefore, artificial means are used to create a sufficiently strong air blast.

—*What is a winnower ?*

Winnower is a machine used for separating grains from a mixture of grain and chaff in an air stream created artificially by the machine. Separation is achieved by allowing the air stream to pass through the mixture. The grain being the heavier material gets deposited at one place whereas the lighter material is flown away from the grain.

Components :

Fan : It consist of impeller on which the blades either three or four in number are mounted in slightly tilted position. The blades are made of mild steel sheet. The rotation of the blades creates air stream or artificial wind.

Frame : The frame is made of either wood, welded sheet, angle irons or any combinations of these.

Driving mechanism : In order to increase the rotational speed of the fans, various driving mechanisms are employed, viz., sprocket and chain, 'V' belt pulleys and single or double reduction gears. Manually operated winnowers are equipped with suitable handle while power operated ones are either directly coupled with the machine or through transmission belts.

Sieves : These are made of mild steel sheets. Sieves are commonly used in modern design of winnowers to attain simultaneous operation of proper grading and cleaning. Sieves of different size of opening holes are used depending upon the size of grain. The sieve is given a shaking motion by means of pitman to ensure thorough shaking of the threshed material.

Hopper : Mounted on the top of frame to feed the threshed material into the machine. This is usually made of mild steel sheets cut to shape and rivetted, welded or folded.

Types : Winnowers are classified as :

— Hand operated
— Pedal operated
— Power operated

General information about the manually operated winnowing fans :

No. of blades	— Approximately four
Blade diameter	— 1.00 — 1.50 m
Speed increase	— 5-9 times
Blower speed	— 200-350 RPM
Distance between winnowing stream and fan	— 1.20—1.80 m

The speed reduction is ensured through gears, pulley belts or sprocket chain arrangements.

9.3 Precautions :

—Winnowing operation should be organised on thoroughly cleaned threshing floor.

—Ascertain the direction of wind and accordingly install the winnower to ensure most effective cleaning.

—Speed of winnower fan should be maintained to 300-350 revolutions per minute to avoid blowing of grain with chaff and straw.

—Lubricate bearings and moving parts.

9.4 Materials required :

i.	Winnower	= 1
ii.	Baskets	= 4
iii.	Broom stick	= 1
iv.	Wooden stands	= 2
v.	Gunny bags	= 2
vi.	Rake	= 1

9.5 Procedure :

—Thresh the harvested crop on threshing floor either the animal treading or any conventional method popularly used in the locality or by a power driven thresher.

—Make heap of the threshed material at a suitable place.

—Ascertain the direction of wind and install the winnower near to the threshed material in such a way that the blast of air to be created by winnower is in the direction of natural wind. Clean the threshing floor.

—Use wooden stand or any available material as a platform and install it on either side of the winnowing fan. Adjust the height of platform in relation to winnowing fan in such a way that the another pupil is able to pour the threshed material with basket at slightly above and front side of the machine for effective separation.

—Take help of two pupils for pouring the material and other two for supplying threshed material to them. Engage another pupil for cleaning the grain with broom continuously. If the winnowing fan is hand operated, employ two pupils for its continuous operation. As the operation is in progress, gunny bags for collecting/filling cleaned grain. Simultaneously rack the straw to stack in a heap properly.

—Give second winnowing, if necessary for the crops like wheat, barley, gram, etc. in which straw or chaff constitutes about 30 to 60 per cent of the total weight of the grain.

9.6 Observations :

The pupil should take the following observations :

—Quality of clean material by measuring chaff removed and clean grain recovered.

—Speed of winnowing fan and relative distance of pouring material from the central line of the fan. Speed should be measured by counting the number of wheel/ pulley revolution.

—Quality of clean grains and extent of grain losses with the straw.

—Quality of straw.

—Total number of pupils required for winnowing operation and out-put of clean grain in unit time.

9.7 Expectcd behavioural outcomes :

The pupil will be able to :

	Grade
—install and operate winnowing fan ; —judge cleaning efficiency ; —control grain losses with the straw.	

The teacher should evalute the pupil for the above abilities.

9.8 Questions :

i. What are the advantages of winnowers over traditional method of winnowing ?

ii. Name various parts of a winnower and explain in brief their functions :

iii. What are the possible reasons for not getting clean grain even by use of fan ?

iv. Why thoroughly cleaned pucca floor is preferred for winnowing operation ?

v. What will happen if the winnowing fan is installed across/opposite to the wind direction ?

10. Activity Unit

OPERATION AND MAINTENANCE OF CHAFF CUTTERS

10.1 Instructional objectives :

The pupil should be able to :

—appreciate the utility of chaff-cutter in preparation of cattle feed ;

—identify the parts of the machine including the mechanism of power transmission;

—understand the factors affecting the performance characteristics of chaff cutter ;

—adjust, operate and maintain the unit.

10.2 Relevant information :

Chaff cutter is also known as ensilage cutter or forage chopper.

—*Components* :

A chaff cutter (See Fig. 10.2.1) consists of the following :

Motor : It is electrically operated, single-phase with a shaft speed of 1440 RPM.

Fly-wheel : It is made of cast-iron for mounting knives and handle.

Knives : These are made of high carbon steel with curved shape fastened through special bolts and nuts.

Feed assembly : It consists of rolls and support which compress and feed the fodder through throat.

Gear assembly : It consists of worm-gear assembly which regulates the cutting length.

Frame : It is the carriage mounted on a stand.

—*Types* :

Chaff-cutters are classified (i) according to the form of cutting head or (ii) according to the power used for operating the machine. According to the form of cutting head :

a) Cylinder type

b) Fly-wheel type

According to the type of power source :

a) Hand chaff cutters or pedal operated chaff cutters.

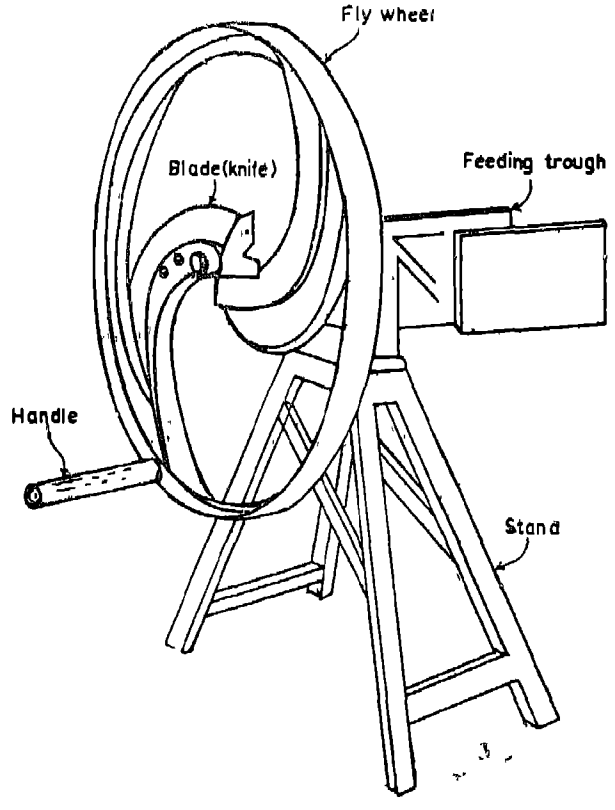


Fig 10 2 1 Chaff Cutter (Rotary Type)

b) Animal operated chaff cutters
c) Power chaff cutters or silage cutters.

—*Capacity* :

Capacity of the power operated chaff cutter is determined by Duffee's formula :

$C = W.H.L.N.R.K$

where, C = Capacity of the machine, tonnes/hour

W = Throat width, cm

H = Throat height, cm

L = Length of cut, cm

N = Number of knives on the fly-wheel

R = Speed of rotary unit, RPM

K = Constant, 2×10^{-5}

—*Materials for construction* :

Cast iron : It is used for making fly-wheel, shear plate, feed rolls and worm gear units.

Mild steel : It is used for making stand, feed trough, etc.

Wood : It is used for making feed trough sides.

10.3 Precautions :

—See that the foundation is rigid and properly fastened.

—Apply grease at nipple and oil lubricants at bearings.

—Sharpen the cutting blades.

—Adjust the clearance between the knives and shear plate.

—Tighten loose nuts, bolts and screws.

—Apply guards for belt-pulley transmission.

—Avoid hammering cast-iron parts.

—Avoid keeping the machine in open space.

—Avoid keeping fly-wheel unlocked when not in use.

10.4 Materials required :

i. *Tools* : Spanner set, screw driver, hammer, lubrication kit, cutting plier.

ii. *Instruments* : Scale, balance, stop watch, caliper.

iii. *Raw material* : Forage crop or straw, plastic wire, plug point, plug socket.

10.5 Procedure :

—Keep the chaff cutter positioned firmly on a stable base.

—Identify the following parts :

i. Motor
ii, Motor pulley
iii. Plug point of 220 v
v. Fly-wheel
vi. Worm gear
vii. Feed roll
viii. Shear plate
ix. Cutting knife
x. Locking device
xi. Feed trough
xii. Outlet chute

—See that the above parts are in a proper place and sequence.

—Check the power line, power drive and rotating unit before switching "on" the motor.

—Switch "on" the motor. Feed the material and watch for the response of the cutting front.

—Measure the length of chaff cut by taking two handfuls of output material. Calculate the average.

—Use stop-watch and measure the quantity of chaff collected in a particular interval.

10.6 Observations :

The pupil should record the following observations and fill up the table :

Dia. of Motor pulley = d_1 = cm.

Speed of motor shaft = n_1 =

Dia. of the fly-wheel = d_2 =

Compute the speed of fly-wheel (n_2)

$$n_2 = \frac{n_1 \times d_1}{d_2}$$

Sl. No.	*Time of start*	*Time of completion*	*Duration*	*Volume of chaff cut*	*Chaff cut per hour*

Prepare a frequency table :

Choose the smallest and longest cut bit.

Divide the size into 5 equal parts.

Count the number of bits and enter them against the corresponding chaff size.

Calculate the mean as follows :

$$\frac{\Sigma fx}{n}$$

where, x = Chaff size
f = Frequency of chaff
n = Total number of chaff

10.7 Calculations :

The pupil should compute the output as per the following formula.

$$\text{Output, Kg/hr} = \frac{\text{Volume of chaff cut, Kg}}{\text{Duration of trial, min.}} \times 60$$

10.8 Expected behavioural outcomes :

The pupil will be able to :

	Grade
—locate the lubrication points;	
—operate the chaff cutter;	
—adjust to vary the length of chaff cut;	
—counter vibration, belt slip and regulate feed.	

The teacher should evaluate the pupil for the above abilities.

10.9 Questions :

i. What are the advantages of cutting chaff ?

ii. What is the use of a ball-bearing in fly-wheel ?

iii. How the length of cut is affected by the speed of feed roll ?

iv. Feed trough is provided (Put a tick mark)

a) near fly-wheel ( )
b) adjacent to shear plate ( )
c) between motor and fly-wheel ( )
d) at the top of the unit ( )

v. How many knives are provided in chaff cutter ?

vi. What will be the degree of each angle If the number of knives were :

a) three

b) four

c) two

vii. There are two knives only in hand chaff cutter, Why ?

viii. What is the speed of revolution in manually operated rotary chaff cutter ?

ix. Give three methods of changing the length of cut in a chaff cutter.

x. What is the type of gear mechanism used for feed control ? Put a tick mark.

a) Super gear ( )

b) Helical gear ( )

c) Worm gear ( )

d) Bevel gear ( )

xi. In a power operated chaff cutter, if the volume of fodder fed in each cut is WHL cubic centimetre prove that the capacity $C = 2 \times 10^{-3}$ (Volume) NR.

xii. The chaff cutter is used to cut the maize stalk. The density of maize chaff is 332 Kg/cubic metre. The number of blades in the operated unit is six. What should be the area of throat cross-section if the output is one tonne/hour and the speed is 800 RPM ?

xiii. Fill up the following table :

Sl. No.	*Name of the part*	*Unit*	*Material*	*Size*	*Purpose*
i.	Fly-wheel dia.	cm		90-135	
ii.	Knives lengh	cm		30	
iii.	Feed trough	cu.cm		3000 cu.cm.	
iv.					
v.					
vi.					
vii.					

11. Activity Unit

OPERATION AND MAINTENANCE OF MAIZE SHELLER

11.1 Instructional objectives :

The pupil should be able to :

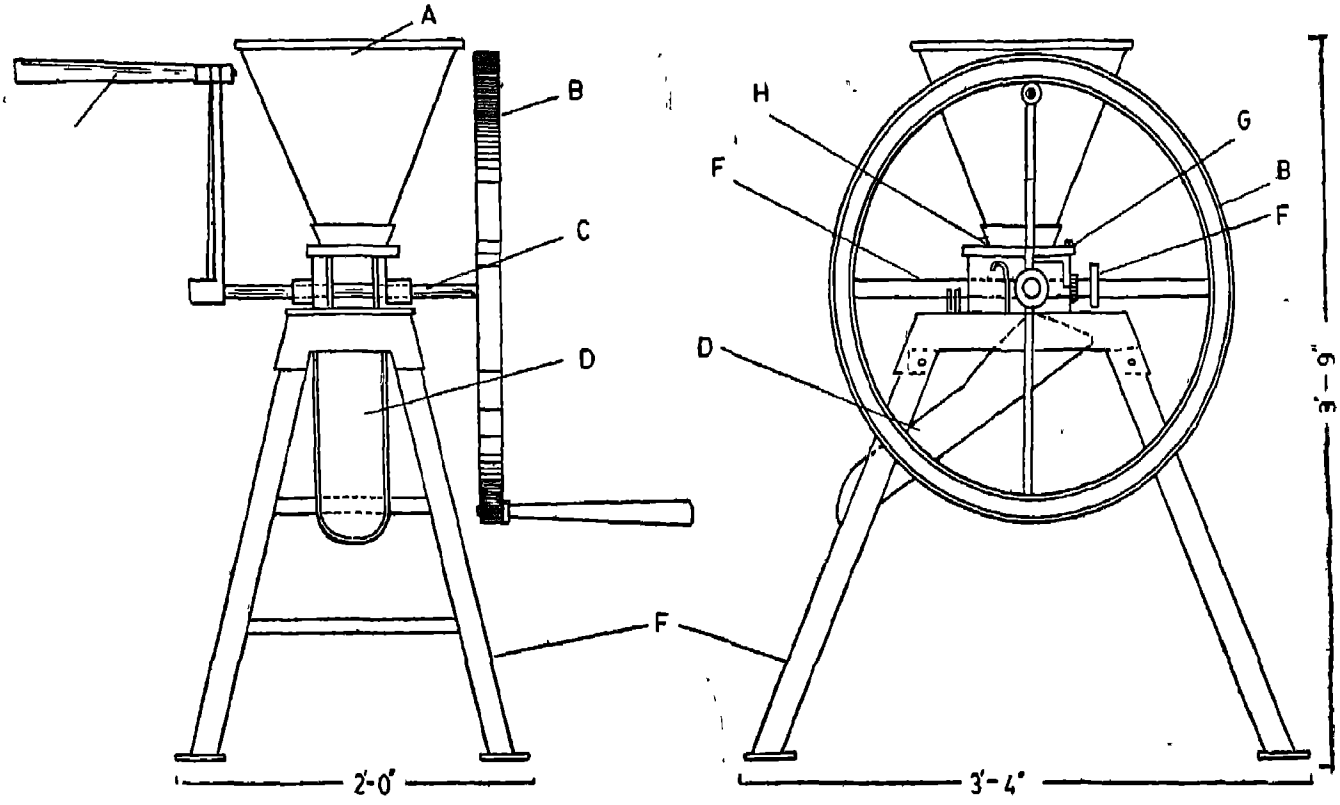
—appreciate the utility of maize sheller in separating seed from cobs ;
—identify the parts of machine including the mechanism of power transmission ;
—understand the factors affecting the performance characteristics of maize sheller ;
—adjust, operate and maintain the unit.

11.2 Relevant information :

Components :

Maize sheller consists of the following components which are shown in figure 11.2.1.

i. Motor is electrically operated single phase with shaft speed of 1440 RPM.
ii. Fly-wheels are made of cast iron and fitted with handle. They provide balance to the machine.



(A) Hopper; (B) Handle; (C) Axle; (D) Trough; (E) Stand; (F) Adjustment screw; (G) Plate ; (H) Crushing roller.

Fig. 11.2.1 Maize Sheller

iii. Shelling disc consist of rolls and provide supports and compresses.

iv. Blower is used for separating seed and husk.

—*Types of maize shellers :*

i. Peg/tooth type

ii. Cylinder type

According to the type of power source, they are :

a) Hand operated and

b) Power operated maize shellers

Capacity

Hand operated—3 to 4 quintals per 8 hours
Power operated—10 to 12 „ „

Material for construction :

Cast iron : It is used in making fly-wheel and bevel gears.
Mild steel : It is used for making stand and hopper.

11.3 Precautions :

—See that the foundation is rigid and properly fastened.

—Apply grease at nipple and oil lubricants at bearings, etc.

—Adjust the clearance between the concave sieves and rollers by compression spring.

—Tighten loose nuts, bolts and screws, springs, belt pulley transmission and foundation.

—Avoid hammering of cast iron parts and keeping the machine in open space.

11.4 Materials required :

i. Tools : Spanner set, screw driver, hammer, lubrication kit, cutting plier, tool box

ii. Instruments : Scale, balance, stop watch

iii. Raw material : cobs, gunny bag, rake.

11.5 Procedure :

—Keep the maize sheller in position firmly on a stable base.

—Clean the machine and identify the following parts :

i. Motor

ii. Motor pulley

iii. Plug points of 220 v

iv. Hopper

v. Locking device

vi. Feed trough

vii. Outlet chute

—Check the power line, power drive and rotating unit before switching on the motor.

—Switch on the motor.

—Feed the dried cobs. Watch for the response of outlet and adjust what is needed.

—See the breakages, if any.

—Use stop watch and measure the quantity of seed shelled in a particular time and calculate in terms of Kg/hour.

—Clean the machine after use and apply lubricants wherever required.

11.6 Observations :

The pupil should record the following observations and fill up the table.

Dia. of motor pulley = d_1 =
Speed of the motor shaft = n_1 =
Dia. of the fly-wheel = d =

Compute the speed of fly = n_2 = wheel

$$n_2 = \frac{n_1 \times d_1}{d_2}$$

Sl. No.	*Time of start*	*Time of completion*	*Duration*	*Speed*	*Weight of cobs, Kg*	*Seed obtained per hour*

11.7 Calculations :

The pupil should compute the output based on the observations above.

$$\text{Output in Kg/hr} = \frac{\text{Weight of cobs in Kg}}{\text{Duration interval in minutes}} \times 60$$

11.8 Expected behavioural outcomes :

The pupil will be able to :

	Grade
—locate the lubrication points; —operate the sheller; —adjust to vary the concave clearance; —counter vibration, belt slip and regulate feed.	

The teacher should evaluate the pupil for the above abilities.

11.9 Questions :

i. What are the advantages of maize sheller ?

ii. What is the use of ball bearing in fly wheel ?

iii. How output of the machine can be increased ?

iv. How the adjustment in machine is made according to the size of the cobs ?

v. What is the speed of revolutions of manually operated maize sheller ?

vi. What is the speed of power operated maize sheller ?

vii. What is the optimum clearance for the cylinder ?

viii. What is the type of gear mechanism used for operating shelling disc ? Put a tick mark.

a) Spur gear
b) Helical gear
c) Bevel gear
d) Worm gear

ix. Give the reasons for the following :

a) Nuts and bolts should be tightened.

b) Compression spring should be properly adjusted.

c) Hopper should be in a particular angle.

d) Handle to be locked when not in use.

x. Fill-up the following table :

Sl. No.	*Name of the part*	*Unit*	*Material*	*No.*	*Size*	*Purpose*
i.	Fly-wheel	cm : dia.	Cast iron	1		
ii.	Hopper	cm. length/width	G.I. sheet	1		
iii.						
iv.						
v.						
vi.						
vii.						
viii.						

12. Activity Unit

OPERATION AND MAINTENANCE OF CASTOR SHELLER

12.1 Instructional objectives :

The pupil should be able to :

—appreciate the utility of castor sheller for shelling castor capsules ;

—know castor sheller and its components ;

—understand operational technique of the machine ;

—perform adjustments and attend to the maintenance of the unit.

12.2 Relevant information :

12.2.1 What is the local method of shelling castor capsules ?

Castor capsules are shelled by beating with sticks and then castor beans are separated from lighter hull material by winnowing and sieving manually. This operation of shelling and winnowing castor capsules is time consuming and laborious. In this method, breakage of seeds is 1·6 % and capacity is only 16 Kg capsules/hr. The cost of operation is approximately Rs. 25/100 Kg of capsules. Shelling efficiency can be taken as 100 %.

12.2.2 What is a castor sheller ?

Castor sheller (See figure 12.2.1) is a machine used for shelling castor capsules and separating castor beans from the empty shells.

—*Components* :

Frame : It is made of angle iron and used for mounting all the other parts.

Cylinder : It is made of wooden planks. The outer periphery of the cylinder is provided with diagonal grooves. The speed of the cylinder varies from 200 to 250 RPM.

Concave : It is made of wooden planks. The inner surface of the concave is provided with diagonal grooves.

Feeding Chute : It is made of G.I. Sheet. The capsules are fed into the machine through feeding Chute (Hopper).

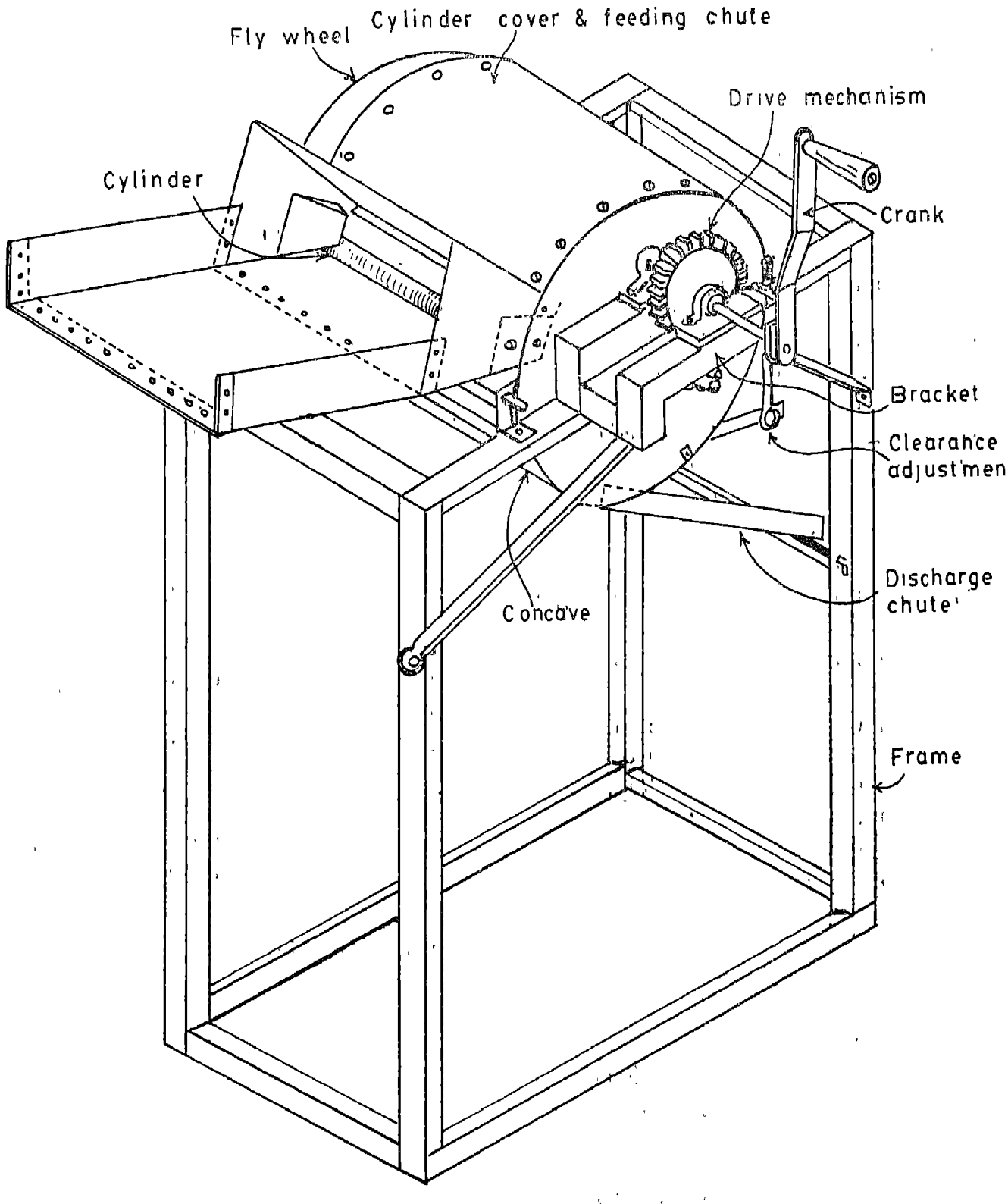
Sieve assembly : It consists of three sieves which are arranged one below the other. The top and middle sieve are provided with outlets at their ends. The bottom sieve is provided with an outlet at its middle.

Fan assembly : It is provided with a fan. The fan is covered by a casing and the entire assembly is placed on the backside of the sieve assembly.

Clearance adjustments : These are done through long bolts which are provided to raise or lower the concave to adjust the clearance between cylinder and concave.

Power transmission : It includes the motor which drives the cylinder through a V-belt and the blower and sieve assembly which are driven from the cylinder shaft through a separate V-belt.

Fly-wheel : It is made of cast iron and is provided in hand operated machines.



Fig, 12.2.1 Castor Sheller

Crank: It is provided in hand operated machines for rotating the cylinder by hand.

Types :

Castor shellers are classified as :

—Hand operated

—Power operated

General information about the hand operated castor sheller :

Power source	— By cranking handle and a set of gears
Speed of the cylinder	— 240 to 250 RPM
Inlet and outlet clearance of cylinder concave	— 14 mm and 6 mm
Capacity	— 150 Kg capsules/ hour
Breakage of beans	— 1%
Shelling efficiency	— 80%
Approx. cost of operation	— Rs. 25.00/100 Kg of capsules

General information about power operated castor sheller :

Power source	— Electric motor of 5 HP or oil engine
Speed of the cylinder	— 250 RPM
Speed of the blower	— 200 RPM
Inlet and outlet clearances of cylinder concave	— 15 mm and 6 mm
Capacity	— 250 Kg capsules/ hour
Breakage of beans	— 0.75%
Shelling efficiency	— 81%
Cost of operation	— Rs. 2.00/100 Kg of capsules.

12.3 Precautions :

—Place the sheller on a leveled ground and fix it with proper foundation bolts.

—Adjust the clearance between cylinder-concave depending upon the type and size of capsules.

—Set outlet for the empty shells in consonance with the direction of wind.

—Lubricate bearings and all moving parts.

—Clean the sieves in between the operation.

12.4 Materials required :

i. Castor sheller
ii. Baskets for feeding the castor capsules
iii. Gunny bags for collecting beans

12.5 Procedure :

—Sundry the castor capsules before feeding to the machine.

—Adjust the clearance between the cylinder and concave and select the size of capsules to be shelled.

—Start the motor and feed the capsules through hopper.

—Take help from your colleague for pouring the material and for collecting the beans.

—Collect the beans in gunny bags.

12.6 Observations :

The pupil should observe and record the :

—speed of the cylinder and blower,

—percentage of broken beans,

—weight of capsules shelled/hour,

—time taken for 100 Kg of capsules,

—weight of unthreshed capsules,

—number of bearings used in the machine.

12.7 Expected behavioural outcomes :

The pupil will be able to :

	Grade
—install and operate castor sheller ; —judge shelling efficiency; —adjust the clearance between cylinder and concave.	

The teacher should evaluate the pupil for the above abilities.

12.8 Questions :

i. What are the advantages of shelling by castor sheller over traditional method of shelling ?

ii. What should be the clearance between cylinder and concave for efficient shelling ?

iii. How the clearance is adjusted ?

iv. How many bearings are required in power castor sheller ?

v. Fill-up the following table :

Sl. No.	*Name of the Part*	*Diameter*	*Width*	*Material and size*	*Purpose*
1.	Fly-wheel				
2.	Cylinder				
3.	Concave				
4.	Sieves				
5.					
9.					
7.					
8.					

13. Activity Unit

OPERATION AND MAINTENANCE OF SUGARCANE CRUSHER

13.1 Instructional objectives :

The pupil should be able to :

—know the various types of sugarcane crushers ;

—identify different parts of the machine and their functions including the mechanism of power transmission ;

—understand operational technique of the machine ;

—understand the factors affecting the performance characteristics of sugarcane crusher.

13.2 Relevant information :

—*What is a cane crusher ?*

Sugarcane crusher is a device used for extracting juice from sugarcane in order to prepare gur, sugar and other sugarcane products. It usually extracts a minimum of 60% of the juice present in the sugarcane on the basis of 12.5 per cent fibre.

Sugarcane crusher consists of the following important components :

Frame : It is usually made of cast iron. It holds the rollers in position and keeps the crusher is stable condition.

Rollers : These are made of cast iron. There are generally three rollers (a) king roller, (b) extracting roller, (c) crushing roller. The number of rollers vary from 2 to 3 in a sugarcane crusher, depending upon the power utilised for operation. The surface of the rollers are properly grooved to have a good grip on sugarcane.

Axles : The axles of the rollers are made of carbon steel having about 0.4 per cent carbon content. The axles are securely fixed to the respective rollers.

Bearings : They are made of Gun metal or lead-tin-bronze and are so assembled that it is easy to lubricate and replace them when desired. Some times well seasoned wood, impregnated with oil is also used as material for bearing.

Gears : The gears may be made as separate pieces or may be cast integrally with the roller shells.

—*Types of sugarcane crushers* :

The sugarcane crushers can be classified into three categories depending upon the power used for operating them :

i. Hand operated,
ii. Bullock operated and
iii. Power drawn sugarcane crushers.

—*General information about Bullock operated sugarcane crushers* :

No. of rollers — 3, King roller, crushing roller and extraction roller

Sl. No.	Name of the part	Dimension/Material	Remarks
i.	King roller	Dia. — 22.5 cm Height — 21 cm	1.25 × 0.63 cm groovings are provided on the surface
ii.	Crushing roller	Dia. — 15 cm Height — 18 cm	1.25 × 0.63 cm groovings are provided on the surface
iii.	Extraction roller	Dia. — 22.5 cm Height — 18 cm	Only vertical groovings are provided on the surface
iv.	Top cover plate	Cast iron	—
v.	Base plate with stands	Cast iron	—
vi.	Bearings	Gun metal	Side thrust, half shell type
vii.	Gear (King roller)	Cast iron 16 cm, 5 cm	Spur gear of full thickness
viii.	Roller axle	High grade steel Dia. — 22.5 cm Height — 9 cm	Press fit to the rollers
ix.	Socket	Cast iron	To receive the beam
x.	Gear (Crushing roller)	Cast iron 22.5 cm, 3.5 cm	Spur gear of half thickness
xi.	Gear (Extraction roller)	Cast iron 22.5 cm, 3.5 cm	Spur gear of half thickness

The bullock operated crusher can crush about 2 to 2.5 quintals of cane per hour. A pair of bullocks and three pupils are required to operate a bullock drawn cane crusher.

—*Some important factors about Bullock driven cane crushers are given below*:

i. The capacity of the crusher increases with the increase in the peripheral velocity of the rollers. It varies between 150 and 225 Kgs per hour.

ii. The percentage of juice extraction is not maximum at the lowest possible gap setting between the rollers.

iii. The power requirement increases with decrease in gap for a particular capacity.

iv. If the operating speed of the bullocks is about 3.2 kmph, a pair of bullocks can crush 3 canes at a time.

v. The extraction percentage goes up slightly if the speed is reduced, but it is not maximum at a very slow speed.

vi. If the crusher jams, the trouble is due to the wearing of rollers. They should, therefore, be re-grooved properly.

vii. If the gap between the rollers is not properly adjusted, the gears are likely to make noise during operation due to friction.

13.3 Precautions :

—Lubricate the bearings and moving parts.

—See that the feeding is continuous and uniform.

—Before starting the crushing operation, ensure that there is no obstruction inside the machine.

—While feeding, see that crop is free from any wooden or iron pieces.

13.4 Materials required :

i.	Sugarcane crusher	1
ii.	Buckets	2
iii.	Sugarcane	
iv.	Yoke	1
v.	Bullocks	2

13.5 Procedure :

—Attach the king roller through a wooden beam to a pair of bullocks, and also connect to the crushing and extraction rollers by means of gears.

—Place a bucket in a pit near the crusher to collect the juice.

—Feed two or more canes between the king and crushing rollers. See that the juice drops on the bed plate from all around the roller periphery.

—Clean the machine thoroughly well, immediately after the use.

—Store the machine when it is not in use, after the season is over.

13.6 Expected behavioural outcomes :

The pupil will be able to :

—install and operate the sugarcane crusher ;

—undertake the correct operation and maintain the sugarcane crusher ;

—control the juice loss.

Grade

The teacher should evaluate the pupil for the above abilities.

13.7 Questions :

i. What precautions are to be taken, in the operation of sugarcane crusher ?

ii. What is the possible reason for not getting expected quantity of juice from the cane while crushing in the sugarcane crusher ?

14. Activity Unit

OPERATION AND MAINTENANCE OF GROUNDNUT DECORTICATOR

14.1 Instructional objectives :

The pupil should be able to :

—appreciate the utility of groundnut decorticator for decorticating groundnut pods ;

—know methods of decorticating by local methods and by machines ;

—identify the parts of the machine including the method of operation ;

—understand the operational technique of the machine ;

—know adjustments and maintenance of the unit.

14.2 Relevant information :

—*What is the local method of groundnut decortication ?*

Mostly groundnut pods shelling is done by breaking the shell by hand pressure under thumb.

– *What is a groundnut decorticator ?*

Groundnut decorticator (Fig. 14.2.1) is a machine for shelling the groundnut pods and separating the groundnuts from the empty shells.

— *Components* : Following are the components of groundnut decorticator.

Frame : It is made of M.S. Angle irons for mounting all other components.

Shelling unit : It consists of grate and crushing plate.

Feeding unit : It consists of hopper, feeder shaft, etc.

Cleaning unit : It consists of fan/blower, sieve.

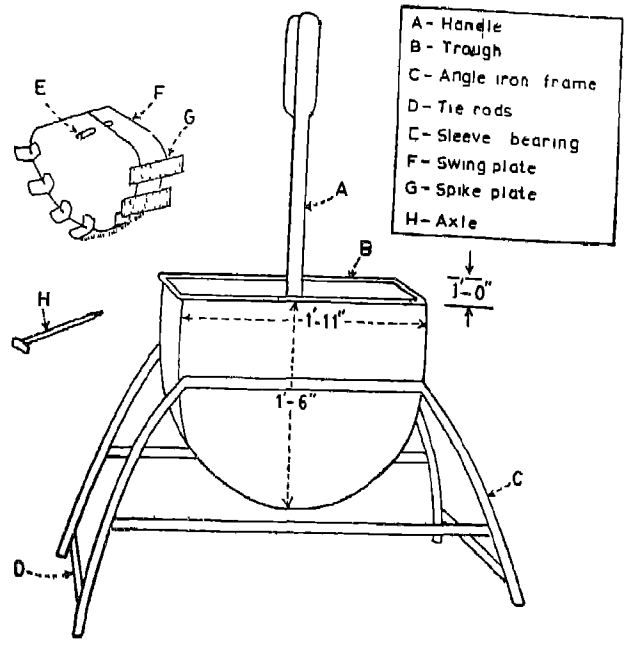


Fig 14 2.1 Groundnut Decorticator

— *Types of groundnut decorticator :*

The groundnut decorticators are classified as.

i. Hand operated and
ii. Power operated

General information about groundnut decorticators :

—The capacity of a power operated groundnut decorticator varies from 2000 to 2500 Kg of groundnut per hour.

—The capacity of a hand operated groundnut decorticator varies from 175 to 200 Kg of groundnut per hour.

14.3 Precautions :

—Place the decorticator on a leveled ground.

— Set the outlet of the empty shells in consonance with the direction of wind.

—Lubricate bearings and all moving parts.

—Clean the sieve in between operations.

14.4 Materials required :

i. Groundnut pods

ii. Gunny bags for collecting the groundnut pods

iii. Basket for feeding the groundnut pods

iv. Groundnut decorticator

14.5 Procedure :

—Sundry the groundnut pods before feeding to the machine.

—Check the machine and place gunny bag at the proper place.

—Feed the pods uniformly to the machine to get good results.

—Collect the groundnut in gunny bag.

—Store the machine when it is not in use after the season is over.

14.6 Observations :

The pupil should observe and record the :

—speed of the cylinder and blower,

—percentage of broken groundnuts,

—quantity of pods decorticated per hour,

—weight of undecorticated pods, if any.

14.7 Expected behavioural outcomes :

The pupil will be able to :

—install and operate the groundnut decorticator ;

—calculate shelling efficiency ;

—adjust the machine for maximum decorticating efficiency.

Grade

The teacher should evaluate the pupil for the above abilities.

14.8 Questions :

i. List out the different types of groundnut decorticators depending upon the power requirement for operating them.

ii. What precautions are to be taken in the operation of groundnut decorticator ?

iii. What is the possible reason for not getting expected shelling efficiency ?

15. Activity Unit

ENERGY GADGETS IN CROP PRODUCTION

15.1 Instructional objectives :

The pupil should be able to :

—understand the difference between energy and power ;

—know about biogas and its role in agriculture ;

—familiarise with wind-mill and its role in lifting water ;

—appreciate solar energy utilisation in crop drying ;

—measure increase in temperature of water due to heating by biogas.

15.2 Relevant information :

Human, animal, mechanical and electrical sources are commonly deployed on the farm in crop production. The gas material derived from biomass is also useful as fuel. Diesel and petrol are used as fuel in engines. Pumps are run by engines (diesel or petrol) or by electric motors. Power sprayers are fitted with small petrol engines while power-tillers and tractors are fitted with diesel engines.

—*Why energy gadgets are required ?*

The modern agriculture involves high yielding varieties, multiple cropping systems, hybrid varieties and mixed cropping. The human energy available to meet the farm demand is not adequate either due to the increased products requiring handling or to the socio-economic constraints resulting from labour exodus from villages to urban areas.

The global energy crisis has introduced another dimension to the scarcity of petroleum products. Alternative non-conventional energy can be tapped from (a) agricultural wastes, (b) Sun and (c) wind. Since India lies in a latitude of 8° to 38° N of equator, solar energy is available in most of the area in abundance. Wind is associated with monsoon. South west and north east monsoons are prevalent in India. Coastal and certain areas experience strong wind velocity for a considerable period in a year. While Sun can give heat energy, wind can give kinetic energy. Farmers owned bullocks, buffaloes and the other animals waste materials can release biogas if digested by micro-organisms in the absence of oxygen. The farm-stead energy needs can be met partially from these sources also. To convert these energy potentials for crop production, it is necessary to couple gadgets that will assist the farm needs. Irrigation pump can be actuated either by wind-mill power or by biogas aided diesel engine pump. Harvested grain can be dried with the aid of solar energy. Wind powered pump can be a centrifugal type. Solar drier is a crop drying unit. These save energy otherwise obtained from electricity or petroleum fuel.

—*Difference between energy and power terms* :

Energy is defined as capacity to do work. Power is defined as rate of doing work. Energy may be in chemical, kinetic or potential form.

a) *Kinetic energy* :

$$K.E. = \frac{1}{2} mv^2$$

Where : K.E. = Kinetic Energy
m = Mass
v = Velocity

b) *Potential energy* :

$$P.E. = m\ g\ h$$

Where ; P.E. = Potential Energy
g = Acceleration due to gravity
h = Head

c) *Chemical energy* :

When methane is burnt with oxygen the following reaction takes place :

$$CH_4 + 2\ O_2 \text{ —— } CO_2 + 2\ H_2O$$

When a blade of a wind rotor rotates, the mass of the blade picks up velocity depending on the wind speed. This imparts kinetic energy to the wind gadget. When the rotor having circular motion is used to actuate a reciprocating pump, water is lifted and stored in a reservoir. If v is the volume of water lifted from a depth h, then

$$P.E. = d\ v\ g\ h$$

Where : d = Density of water

If solar radiation is allowed to fall on a black body or black metal surface, the temperature of the black body rises resulting in the release of radiant energy.

Heat energy radiated : $= E\ \sigma\ T^4$

Where : σ = Stefan Boltzmann's constant
T = Temperature of the hot surface
E = Emissivity (usually 0.9)

Energy is usually expressed in calories, joule, dyne, erg, foot-pound, watt-hour, and horse power-hour.

Power is the energy per unit time. Hence if power is to be measured, duration of application of energy should be reckoned. A pair of bullocks can release about one horse power. It is rate of doing work, if a pair of bullock work for six hour, it has released an energy of 6 horse-power hour. Biogas has an energy of 3500 K Cal/m^3. This means if one cubic metre of biogas is burnt it will release an energy of 3500 kilocalories. If three cubic metre of biogas is burnt in four hours, then power available is :

$$\frac{3 \times 3500}{4} = 2625 \text{ K Cal/hour}$$

—*What is biogas ?*

Biogas is a gas released during the fermentation of biomass like animal dung in the absence of oxygen i.e. under anaerobic condition. Biogas is a mixture of methane (CH_4) and carbon dioxide (CO_2) with traces of water vapour (H_2O). Normally biogas contains 60% methane and 40% carbon dioxide. Methane is a good fuel. It belongs to paraffin family ($C_n\ H_{2n+2}$). The other members of the family are butane and propane. Methane can not be liquified easily under normal

temperature or/and pressure. Pungent smell is the characteristic of biogas. Presence of carbon dioxide does not affect the burning quality of biogas significantly.

—*What are the types of biogas plants ?*

There are two types of biogas plants. They are :

a) Drum type and b) Dome type. The drum type (Fig. 15.2.1) unit consists of a metallic gas holder which stores biogas. In dome type (Fig. 15.2.2) unit, biogas is stored in the space provided above the slurry. In dome type plant there is neither moving part nor metallic element. This helps elimination of corrosion problem, which is otherwise encountered as in drum type model. The following diagrams illustrate the schematic representation of the two types.

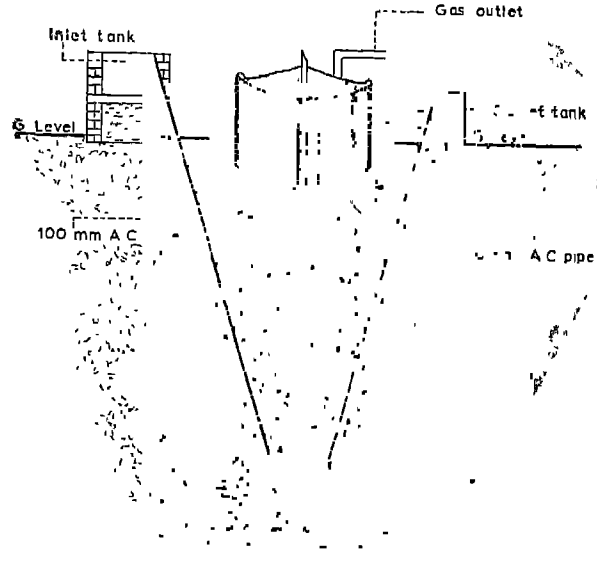


Fig. 15 2 1 Biogas Plant (Drum Type)

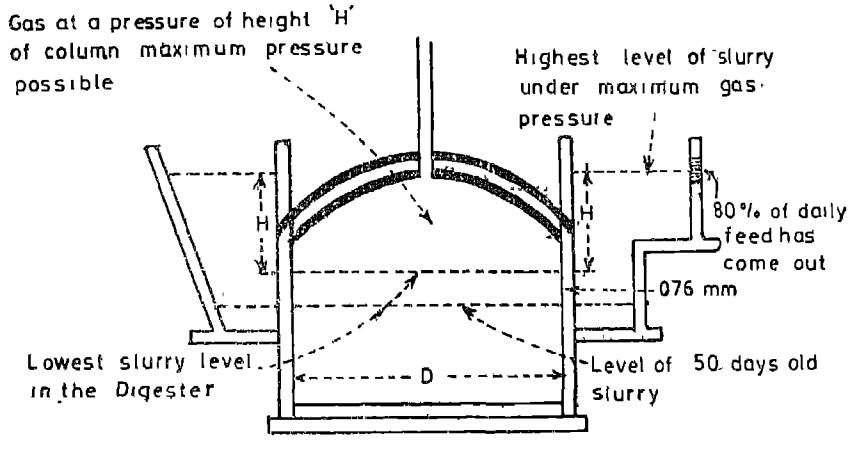


Fig. 15.2.2 Biogas Plant (Dome Type)

—*How biogas helps present day agriculture ?*

The cattle dung and agricultural wastes are used as compost and manure. When these wastes are recycled through biogas plant, the digested slurry is useful as manure. Biogas is received as by-product. The biogas helps the farmer in the following ways :

a) Biogas fuel substitutes wood fuel.

b) Biogas run engine saves petroleum products.

c) Biogas lighting compensates the absence of electrical lighting.

d) The foul odour of the wastes is reduced in slurry during digestion.

e) Obnoxious weed seed like Parthenium are killed due to anaerobic action during digestion.

—*How a biogas plant is commissioned ?*

The biogas plant is charged with animal dung. The slurry to be charged is prepared by adding equal amount of water to the dung and by thoroughly mixing them. When the slurry is displaced out of outlet, it can be mixed with irrigation water or transported to the needy area. One cattle dung caters the cooking fuel requirement of one family member. The capacity of a biogas plant is specified by the volume of biogas produced in a day. Biogas plants that are commonly recommended for individual ownership are 2 m^3, 3 m^3, 4 m^3 and 6 m^3.

—*What is a commonly used biogas gadget ?*

Cooking stove is a biogas gadget. This may be of earthen material or of sheet metal. Air is to be regulated appropriately to burn the stove properly. A low cost burner can be constructed as follows :

a) Take a 45 cm dia. G.I. pipe of 30 cm length.

b) Take two 15 mm thick circular sheets of 45 cm dia.

c) Weld these two sheets on either sides of the pipe.

d) Drill 6 mm dia. hole on one of the circular sheets radially.

e) Provide a nipple at the bottom to let the biogas into the pipe cylinder.

f) By providing suitable stand of adequate height, the burner is ready to be used as an stove.

—*Wind powered water lift* :

Wind mill consists of a large diameter vane wheel or rotor fixed on the top of a tall steel and wooden tower. A plunger type reciprocating pump is located at the bottom. Suction pipe is immersed in the well below. When a strong wind blows, it rotates the vane wheel which in turn operates the reciprocating pump. The delivery pipe rises to a reservoir where the water is stored to be used when in demand.

—*Solar drier* : Solar drier components are :

a) Flat plate collector

b) Blower-duct assembly

c) Plenum chamber

d) Grain holding perforated base

Flat plate collector is the main component which absorbs solar energy and heats the black coated iron-sheet placed below a 3 mm thick glass sheet. When blower sucks air from atmosphere, thin layer of heated air comes through the duct assembly. Plenum chamber distributes heated air through the thin bed of moist grain placed over the chamber. The hot air removes the moisture from the grain and renders the grain fit for storage.

15.3 Precautions :

—Biogas plant should have been charged enough to produce gas,

15.4 Materials required :

i. Flow meter
ii, Burner
iii. Matches
iv. Thermometer
v. Utensil
vi. Water
vii, Stop watch
viii. Plastic tube

15.5 Procedure :

—Connect the nipple of the biogas outlet with a plastic tube.

—Connect the other end of the plastic tube to the inlet of flow-meter.

—Connect the outlet of flow meter to the burner.

—Take one litre of water in the utensil and measure initial temperature.

—Open the outlet and take initial reading of flow meter. Start stop watch, lit the burner.

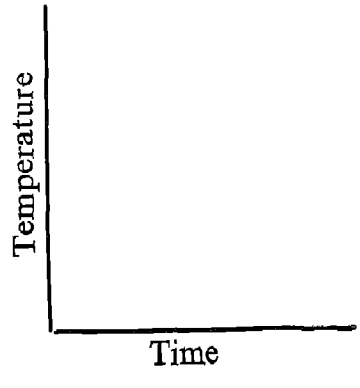
—Measure the temperature of water and flow meter reading at regular intervals.

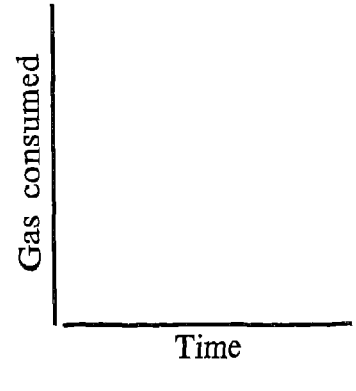
15.6 Observations :

a) The pupil should take and record the following observations in the table given below.

Sl. No.	*Flow meter reading*		*Water temperature*	
	Initial	*At the end of every 15 minutes*	*Initial*	*At the end of every 15 minutes*
1.				
2.				
3.				
4.				
5.				

b) The pupil should plot the following graphs





c) The pupil should tabulate the observations and calculate calorific value and heat contents.

Sl. No.	*Time*	*Gas consumed*	*Temperature rise*	*Calorific value*	**Heat contents mCp ($\triangle t$)*

* m = mass of water — 1000 g
Cp = specific heat — 1.0
$\triangle t$ = temperature difference — °C

15.7 Expected behavioural outcomes :

The pupil will be able to :

—understand operations of biogas plant, wind mill and solar driers ;

— understand the role of biogas, wind mill and solar driers in agriculture ;

—measure increase in temperature due to heating by biogas.

Grade

The teacher should evaluate the pupil for the above abilities.

15.8 Questions :

i. What is the single basic dimension which differentiates power from energy?

ii. What are the constituents of biogas ?

iii. What are the advantages of dome type biogas plant ?

iv. How non-conventional energy can be used to operate centrifugal and plunger pump ?

v. How chemical energy can be converted into mechanical energy ?

vi. Identify areas where non-conventional energy can be useful in crop production.

APPENDIX—I

LIST OF CONTRIBUTORS

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APPENDIX—II

SUGGESTED READINGS

—Anon, 1974. Guide to selected improved hand tools ; Bulletin series—No. 11 for the participants of International Agricultural Machinery Manufacturing Development Clinic (A joint--UNIDO—India Project), Tractor Training Centre, Government of India, Hissar.

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—Davidson, J. B. 1948 Agricultural Machinery, John Willey' and Sons, Inc., New York.

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—Roy, Bainer. ; Kepner, R. A. and Barger, E. L. 1960. Principles of Farm Machinery, John Willey and Sons, Inc., New York.

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—Smith, P. H. 1964. Farm Machinery and Equipment, 4th Ed., Mc-Graw Hill Book Co., New York.

APPENDIX—III

CONVERSION OF BRITISH INTO METRIC SYSTEM UNITS

Length	1 yd (yard) = 3 ft (feet) = 36 in (inches) = 0.9144 m. 1 ft = 0.3048 m ; 1 in = 2.54 cm.
Area	1 sq. yd = 0.863 sq. m. ; 1 sq. ft = 0.0929 sq. m. 1 sq. in = 6.452 sq. cm.
Volume	1 cu. ft = 0.02832 cu. m. = 28.32 litre ; 1 cu. in = 16.39 cu. cm ; 1 gal (gallon) = 3.7852 litre.
Weight	1 ton = 1,000 kg

CONVERSION FACTORS

Measure	*British*			*Metric*		
	Unit		*To convert British to Metric*	*Unit*		*To convert Metric to British*
Length	Inch (″)	×	25.4	mm = $\frac{1}{1000}$ m	×	0.03937
	Feet (′) = 12″	×	0·305	m	×	3.28
	Yard = 3′	×	0.9144	m	×	1.0936
	Mile = 1760 yd	×	1.609	km = 1000 m	×	0.621
Area	Sq. in.	×	6.451	cm^2	×	0.155
	Sq. ft.	×	0.0929	m^2	×	10.76
	Acre	×	0.4047	hectare	×	2.471
Volume	Cub. inch	×	16.387	cm^3	×	0.0610
	Cub. ft.	×	28.32	litre	×	0.0353
Velocity	Ft/Sec	×	0.3048	m/sec	×	3.28
	Ft/Min	×	0.00508	m/sec	×	196.85

APPENDIX—IV

STATE AND UNION TERRITORY—WISE LIST OF FIRMS MANUFACTURING AGRICULTURAL IMPLEMENTS

1. Andhra Pradesh	1. M/s Deccan Seed Stores Purshottam Nivas, Basheer Bagh, Hyderabad.	Agricultural implements
	2. M/s Mekins Agro Industrial Enterprises S-16, Industrial Estate, Phase-II, Balanagar, Hyderabad.	Agricultural implements
	3. M/s Krashak Industries 18-3-14, Laldarwaza, Chatrinqa, Hyderabad-500253	Agricultural implements, well cleaning crenes and agril. machinery.
	4. M/s Aruna Industries Plot No. 119-B, Industrial Complex, Khattedan, Hyderabad-500252	-do-
	5. M/s Swastic Manufacturers 13/1, Azambad Industrial Area, Mushcerabad, Hyderabad-500020	Ploughs, weeders, seed drills and trailors
	6. M/s Ritiset Industries Gudivada-521301, Krishna Dist.	Tractor drawn implements and trailors
	7. M/s Eswar Industries A-1 (a), Industrial Estate, Gudivada-521301 Krishna Dist.	-do-
	8. M/s Srinivasa Auto Engineering Works Industrial Estate, C-2 and C-3 plots, Gudivada-521301, Krishna Dist.	Trailors and agricultural implements
2. Bihar	9. M/s Arthur Butler & Co. Muzzafarpur.	Agricultural implements
	10. M/s Bhanamal & Co. Mithapur, Patna.	-do-
	11. M/s Bharat Agricultural & Mechanical Engg. Alamganj, Patna-7	Winnowing fans
3. Delhi	12. M/s Bali & Co. 168, Chandni Chowk, Delhi	Plant protection equipment, secateur, chaff cutter, tree pruner

	13. M/s Civil Engg. Co. Arya Samaj Road, Karol Bagh, New Delhi.	Wheel-barrows, carts, garden rakes, augers and other implements
	14. M/s Dinanath Balmukund Naya Bazar, Delhi.	Chaff cutter blades
	15. M/s Shaw Wallace & Co. 9-A, Connaught Place, New Delhi.	Plant protection equipment
	16. M/s Tata Iron & Steel Co. Ltd. Sales Branch Office, Shyam Bhawan, 15/1, Asaf Ali Road, P.B. No. 581, New Delhi.	Agricultural implements Agricultural implements
	17. M/s Union Tractors Ltd. 126-Phase I, Industrial Estate, Naraina, New Delhi.	Agricultural implements
4. Gujarat	18. M/s Bharat Iron Works Bilmoria, Dist. Surat.	Agricultural implements
	19. M/s Krishi Sadhan Kendra Mahadoo Nagar, Bilmoria, Surat.	Ploughs, bakhars, hoes, Baroda hoes, puddlers, winnowers
	20. M/s Bharat Iron Works Station Road, Ahmedabad	Agricultural implements
5. Himachal Pradesh	21. M/s Nahan Foundry Ltd. (Govt. of India concern) Nahan.	Maize shellers, sugarcane crushers, pumps and ploughs
6. Haryana	22. M/s Laldee (P) Ltd. Faridabad.	Chaff cutter blades
	23. Govt. Engineering Workshop, Nilokheri, Dist. Karnal.	Winnowing fans, hoes, sweep, shears.
	24. M/s Mukand Lal Gaba C/41, Sabzimandi, Karnal.	Wheel hoes and other agril. implements
	25. M/s National Engineering Co. Saphi Road, Ambala City.	Seed drills, trifali ploughs, etc.
	26. M/s Pratap Iron Works Chaura Bazar, Karnal.	Agricultural implements
7. Kerala	27. Co-operative Workshop Noyatinkara.	Pumps, weeders

	28.	M/s Kumar Industries Post Edathara, Malabar.	Agricultural implements
8. Karnataka	29.	M/s Mysore Machinery Manufacturers Mysore Road, Bangalore.	Agricultural implements
	30.	M/s Shio Industries Ltd. Mandipet, Tumkur.	Deshmukh wheel barrow
	31.	M/s The Stali Structural Mechanical Engineering Works, Hassan	Agricultural implements
	32.	M/s St. Joseph's Asylum Industrial Workshop Mangalore (S. Kanara Dist.).	Agricultural implements
9. Madhya Pradesh	33.	M/s Central India Engg, Corporation Hamidia Road, Bhopal.	Agricultural implements
	34.	M/s Simplex Ltd. Madan Mahal, Jabalpur.	Agricultural implements
10. Maharashtra	35.	M/s Agriculture Orient Industries Ltd. 98, Medows Street, Fort, Bombay.	Plant protection equipment
	36.	M/s American Springs & Pressing Works Ltd. Narve Road, Malad, Bombay-46.	Dusters, sprayers, paddy threshers, cultivators and seed drills
	37.	M/s Bharat Pulverizing Mills Ltd. 38-A, Sayani Road, Bombay-28.	Dusters & sprayers
	38.	M/s Mandehar Bros. Ltd. Sangle	Ploughs, groundnut decorticators
	39.	Govt. Central Workshop Sadar, Nagpur.	Sieves, paddy weeders, seed broadcasters
	40.	M/s Gothi Iron & Metal Workshop Ltd. Singata, Tank Road, Nasik.	Agricultural implements
	41.	M/s Krishi-Go-Sevak Kendra Pipri (Near Wardha)	Bullock-drawn implements
	42	M/s Petanjee Pocha & Co. Ltd. 8, Napier Road, Poona.	Garden tools
11. Punjab	43.	M/s Batala Engg. Co. Ltd. Lohamandi, Batala, Dist. Gurdaspur.	Agricultural implements
	44.	M/s Dalip Singh & Sons Tanda Road, Jalandhar City.	Agricultural implements

	45.	M/s Labh Singh Karan Singh Tanda Road, Jalandhar City.	Agricultural implements
	46.	M/s Prakash Engg. Works G.T. Road, Batala, Dist. Gurdaspur,	Agricultural implements
	47.	M/s Wathins Mayer & Co. Ladowalo Road, Jalandhar City.	Agricultural implements
	48.	M/s Jai Singh Sukhdeo Singh Samrata.	-do-
	49.	M/s International Manufacturing Co. Jargaon.	-do-
	50.	M/s Union Forging, Serpur	-do-
	51.	M/s Friends Own Foundry, Ludhiana,	-do-
12. Tamil Nadu	52.	M/s LCT Industries Trichy Road, Coimbatore.	Agricultural tools
	53.	M/s Hema Industries, Coimbatore.	Agricultural machinery
	54.	M/s Farm Equipments Co. Ltd. Coimbatore	Agricultural implements
	55.	M/s Bhavaneswari Industries, Coimbatore.	Threshers
	56.	M/s Thewar Co. P.O. Melure, Madurai.	Bose (Melur) plough
	57.	M/s National Engg Co. (Madras) Pvt Ltd. 127, Anagappa Naik Street, Madras-600001.	Power tillers & matching equipment, threshers, pumps & sprayers
13. Uttar Pradesh	58.	M/s Agrawal Iron Foundry Hewtett Road, Agra.	Agricultural implements
	59.	M/s Agricultural Development Society Naini, Allahabad.	Agricultural implements (ploughs, hoes, pumps, cultivator, Nagpuri yoke).
	60.	M/s Agricultural Engg. Workshop Talkatora, Lucknow.	Agricultural implements
	61.	M/s Cossul & Co. Ltd. 14/78, Mahatma Gandhi Marg, Kanpur.	Ploughs, harrows, cultivators, seed-drills, reapers, threshers, winnowers and other agril. plant protection equipment.

	62. M/s Delhi Engg. Co., Meerut.	Agricultural implements
	63. M/s Kumaon Nursery Ram Nagar, Nainital.	-do-
	64. M/s Raj Engineering Works Ltd., Sitapur.	-do-
	65. M/s The Rohilkh and Industries (Workshop) Opposite S.M. Inter-College, Kulharapur, Bareilly.	Agricultural implements
	66. M/s Shankar Iron Foundary P.O. Shahaganj, N. Rly., Distt. Jaunpur.	-do-
	67. M/s Universal (Agriculture) Machine Corporation, Bijnore.	-do-
14. West Bengal	68. M/s Carl Holemes and Co. (P) Ltd. 28, Waterloo St, Calcutta.	Garden tools and seed drills
	69. M/s Hammam Engg. Works 34 & 36 Jatindra Mohan Avenue, Calcutta.	Agricultural implements
	70. M/s Jardine Henderson 4, Clive Road, Calcutta.	Plant protection equipment
	71. M/s T.E. Thomson & Co 9-E, Esplanade East, Calcutta.	Agricultural implements

APPENDIX—V

Questionnaire for collecting opinion of the

Teachers and Pupils

On The

INSTRUCTIONAL - CUM - PRACTICAL MANUAL

ON

FARM MACHINERY

DEPARTMENT OF VOCATIONALIZATION OF EDUCATION
National Council of Educational Research and Training
Sri Aurobindo Marg, New Delhi - 110 016

1984

Dear Teacher/Pupil,

We are happy to place this Instructional-cum-Practical Manual at your disposal with the hope that it will help you conduct some of the practical works prescribed in the syllabus or practices necessary to gain thorough vocational expertise.

The Manual does not conform to syllabus of any particular state but includes most of the important activities common in syllabi of different states. This is an experimental edition with ample scope for further improvement through feed-back from you. We solicit your active co-operation for the improvement of the Manual.

After having used the Manual for a year or more, kindly read the appended questionnaire carefully and write down the answers precisely and exactly-to-the-point. Use additional sheet of paper if the space provided for is insufficient. Fold the questionnaire accurately and mail it to the following address :

Dr. A. K. Sacheti
Programme Coordinator
Department of Vocationalization of Education,
National Council of Educational Research and Training,
Sri Aurobindo Marg, New Delhi - 110016

QUESTIONNAIRE FOR THE TEACHERS

INSTRUCTIONAL-CUM-PRACTICAL MANUAL ON.....

A. Name of the Teacher
(in block letters) .....

B. Name & Postal Address of the Institution .....

.....

.....

C. i) Qualification.....

ii) Teaching Experience.....

.....

.....

iii) Professional or Field Experience .....

.....

.....

1. Do the activities covered in the Manual develop vocational expertise in the pupils ?
Yes/No

2. List the activities included in the Manual which do not figure in the syllabus.

.....

.....

.....

.....

.....

.....

3. List the activities included in the Manual which do not figure in the syllabus, but are vocationally important.

.....

.....

.....

4. List the activities prescribed in the syllabus but not covered in the Manual

.....

.....

.....

5. List the vocationally important activities which are neither included in the Manual nor prescribed in the syllabus

.....

.....

6. Are instructional objectives pertaining to each activity unit rational? If not, list down the irrational, irrelevant or vague ones.

Activity Unit *Irrational/Irrelevant/Vague objective*

.....

.....

.....

7. a) Does the relevant information given under every activity unit furnish enough theoretical background of the activity?

Yes/No

b) If not, list the Activity Units where relevant information needs further modification.

Activity Unit *Portion* *Type of modification needed*

.....

.....

.....

.....

8. a) Does the relevant information contain any factual errors or inaccuracies ?
Yes/No.

b) If yes, give the details.

Activity Unit	*Error/Inaccuracy*	*Should read*
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

9. Did you notice any expressions/sentences in the manual which do not carry precise meaning or information ? If yes, then give the details.

Page No.	*Expression/Sentences*	*Would be more appropriate*
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

10. Does accomplishment of the Activity Units result in realization of objectives in terms of behavioural outcomes in the pupils? If not, point out the behavioural outcomes mentioned in the manual, which you feel are difficult to achieve through a particular activity unit ?

Activity Unit	*Behavioural outcomes*
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

11. Is the procedure for Activity Unit well sequential? If not point out the discrepancies along with your own observations or suggestions.

Activity Unit *Discrepancy/Observations/suggestions*

.....

.....

.....

.....

12. Did you notice any inaccuracies/discrepancies in the diagrammes illustrating activity Units? If yes, point them out.

Illustration No. *Discrepancy/Inaccuracy*

.....

.....

.....

.....

.....

13. Your overall opinion about the Manual which may be useful in the effective improvement of the manual.

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QUESTIONNAIRE FOR THE PUPILS

1NSTRUCTIONAL-CUM-PRACTICAL MANUAL ON.....

A. Name of the Pupil
(in block letters).....

B. Name and address of
the school/college .....

... .

C. Class .. ..

D. Medium of instruction... .....

1. Enlist the portions of the Manual which you found difficult to understand and give reasons.

Activity Unit	*Portion of the Text*	*Difficulty experienced*

2. Mention the places where you found the language to be difficult.

Activity Unit	*Page No.*	*Difficulty experienced*

3. Point out the figures/illustrations which do not help in understanding the topic/ theme.

Illustration No. *Your observations/difficulty experienced*

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4. Can you conduct the activity units yourself with the help of this manual ?

Yes/No

If not, point out the portions of Activity Units which need further elaboration or explanations.

Activity Unit *Portions to be elaborated*

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5. Was relevant information given in the Manual useful to you in the examination ?

Yes/No

6. Do you know the scientific reason behind steps that you take in the conduct of different Activity Units ?

Yes/No

7. Your overall candid opinion about the Manual.

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